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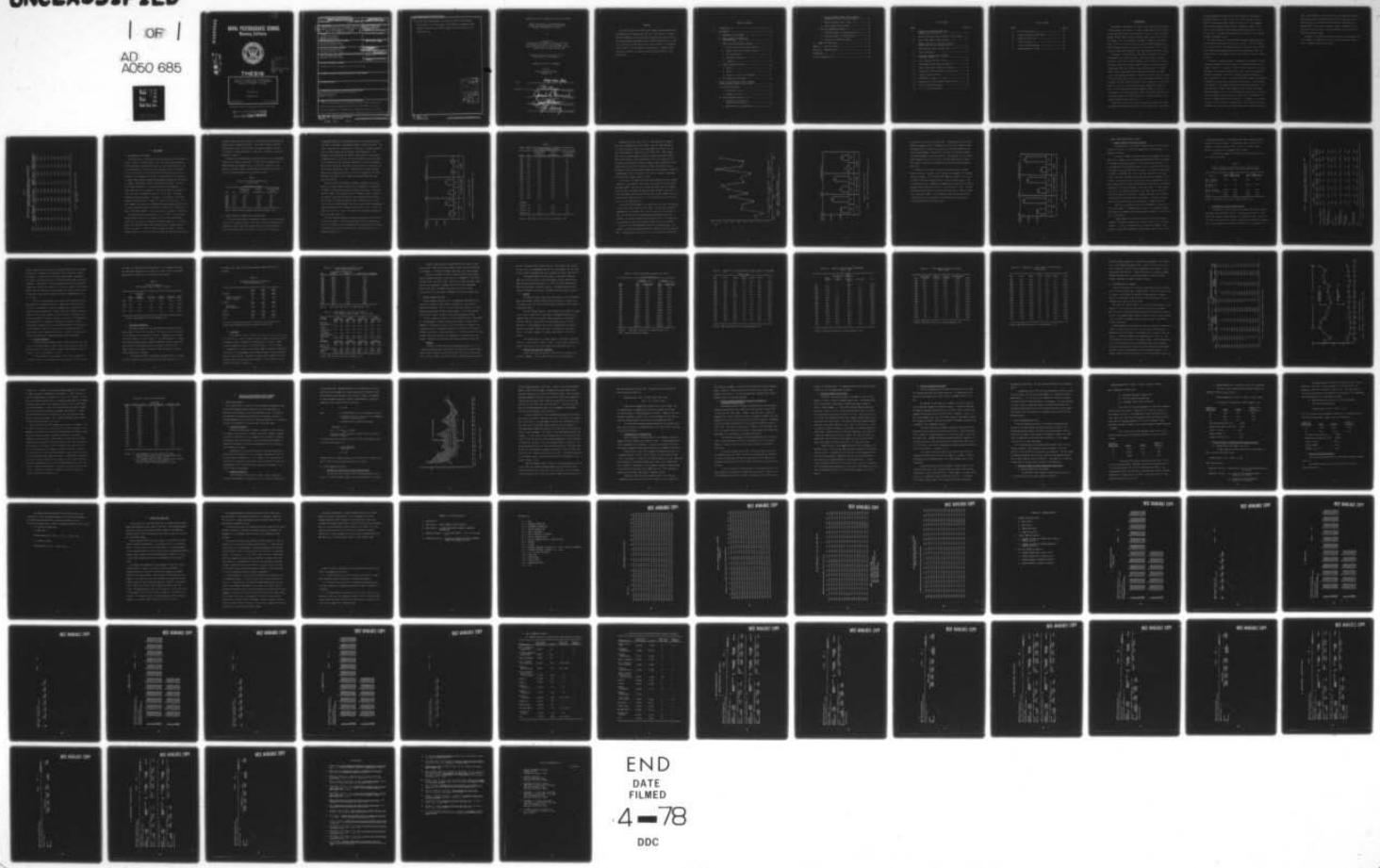DEC 77 Y C KIM

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

STATISTICAL ANALYSIS OF THE RELATIONSHIP
BETWEEN THE DEFENSE BURDEN AND THE ECONOMIC
GROWTH OF THE REPUBLIC OF KOREA

by

Yong Chan Kim

December 1977

Thesis Advisor: J. D. Buttinger

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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Statistical Analysis of the Relationship
Between the Defense Burden and the Economic
Growth of the Republic of Korea

by

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ABSTRACT

This study concerns the relationship between defense expenditures and economic growth between 1961 and 1976 in the Republic of Korea. The chief emphasis is on statistical and economic analysis of the relationships between the defense burden (defense expenditures as a percent of GNP) and the GNP growth rate (rate of change in 1970 constant value of GNP). Also considered is the effects of investment rates, foreign aid receipts, and other economic variables concerning this relationship.

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I. INTRODUCTION

The economy of the Republic of Korea (R.O.K.) has grown very rapidly and remarkably since 1961. This study concentrates on the relatively short but significant period from 1961 to 1976. In 1976, the Gross National Product (GNP) of R.O.K. reached a record 4,757 billion won in 1970 terms. This is a 400 percent increase if compared to the GNP of 1961 of 1185 billion won. During this period, defense expenditures have increased from 66 billion won to 277 billion won. This is a 420 percent increase when compared to 1961 [see Appendix statistical data].

The Republic of Korea (R.O.K.) must meet two burdens. One is the development of the nation's economy. The other burden is national security in the form of national defense. After World War II, the nation was divided into two parts, North and South. From that time the Korean people have had to endure a heavy defense burden. In recent years, the arms race between North Korea and the Republic of Korea (R.O.K.) has become more severe. According to the World Military Expenditure and Arms Trade (1975) [6], in just one decade (1965-1975), R.O.K. has spent the total amount of $3.635 billion on defense. In 1973 constant U.S. dollars, this required an annual average of 4 percent of GNP. On the other hand North Korea has spent $6.425 billion, or a 13.6 percent of the annual average of GNP. Thus, North Korea has dedicated approximately two times the amount of internal spending for defense purposes than has the R.O.K.

Considering that R.O.K. is under the constant threat of bellicose challenge from the North, and that military aid from the United States

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has almost ceased (i.e. most U.S. troops in Korea will be gradually withdrawn beginning in 1977), R.O.K. will have to provide the huge amount of the defense budget through her own efforts. This suggests that the Korean defense budget might be increased even more in the future since a large portion of defense assets were obtained from U.S. military aid. This heavier defense burden on the GNP will strain other economic development plans.

This thesis deals with the relationship between defense expenditure and economic growth between 1961 and 1976 in R.O.K. The chief emphasis is on the statistical and economic analysis of the relationship between the defense burden (defense expenditures as a percentage of GNP) and growth factors of the economy, so as to gain insight for future economic planning.

In Chapter II, general growth of the economy and patterns of change concerning the major structural factors of the economy are briefly discussed. Chapter III is devoted to the statistical analysis of the chief variables, covering both the statistifal results and the methodological problems encountered. Statistical hypothesis testing methodology is used to determine if there is a strong relationship between the variables or between one variable and another set of variables by a multi-regression analysis. Since defense expenditures have been composited in the past from both the nation's own budget and U.S. military assistance; under the assumption of no military assistance from the U.S., past data can be adjusted to show what the R.O.K. would have had to bear alone in terms of a defense burden during that period. In Chapter III, the statistical analysis is shown in two ways; one is the relationship on the assumption that the portion of defense expenditure is borne only by the

R.O.K., and the other is the relationship on the assumption that defense expenditures include both the nation's own budget and the military assistance. Since the mid 1970's the R.O.K. government has assumed most of the burden of defense. Hence the assumption of including military assistance in the past domestic burdens gives the model more predictive power.

In summary, this thesis discusses the effect of the defense burden to the Republic of Korea and will also provide a basis for further study in determining prediction factors.

TABLE I

COMPARISON OF DEFENSE EXPENDITURE BETWEEN R.O.K. AND NORTH K.
(1973 Constant in Million U.S.$)

YEAR	DEFENSE EXPENDITURE		G N P (mil.US $)		PERCENT OF G N P		DEFENSE PER CAPITA	
	R.O.K.	N K	R.O.K.	N K	R.O.K.	N K	R.O.K.	N K
1965	200	487	5380	3480	3.7	14.0	7.1	40.3
1966	237	474	6050	3930	3.9	12.1	8.1	38.2
1967	254	617	6510	3940	3.9	15.7	8.6	47.4
1968	297	769	7340	4410	4.1	17.4	9.7	15.4
1969	342	740	8440	4810	4.1	15.4	11.1	53.6
1970	359	799	9100	5140	3.9	15.6	11.4	56.3
1971	424	819	9920	5350	4.3	15.3	13.3	56.1
1972	479	528	10600	5600	4.5	9.4	14.8	35.0
1973	461	625	12400	5700	3.7	11.0	14.0	40.3
1974	582	567	13500	5530	4.3	10.2	17.4	35.4

Source: World Military Expenditures & Arms
Trade (1975)

II. THE ECONOMY

A. BACKGROUND OF THE ECONOMY

After World War II, Korea was divided and occupied by two victorious
allies. South of the 38th parallel line, the country was occupied by
the United States of America and north of it by the Soviet Union. The
joint occupation of this nation by the two powers led to the current
division of the nation into two hostile political entities. With in-
auguration of the Republic of Korea in the southern half of the country
in August 1948, the newly established government exerted serious efforts
to restore a semblance of order for the national economy. The favor-
able trends thus set off in the national economy as evidenced by a
record GNP growth of 9.7 percent in 1949 were brought to an abrupt and
total halt when the Korean War broke out in June 1950. The Korean
economy was thrown once again into chaos. The Korean War (1950-1953)
reduced to ashes almost all industrial potential of the country. The
total damage inflicted by the three-year war was estimated at $3 billion.
The annual economic growth of the country suffered a 15.1 percent set-
back in 1950 and 6 percent in 1951, gaining only 1 percent in 1952 [19].

The Korean Armistice took effect on July 27, 1953. The government
concentrated its effort on the rehabilitation of the war-devastated
country, while trying to strengthen the defense capability. As a result,
during the 1954-1957 period, real GNP grew rapidly, averaging about 5
percent per annum. In 1957 the nation achieved a record 7.7 percent
economic growth. The only relatively bad year was 1956 when agricultural

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production declined almost 6 percent. Mining and manufacturing output grew by about 15 percent per annum. By contrast the period 1958 to 1960 was one of declining GNP growth, and began a downward curve to 5.2 percent in 1958, 3.9 percent in 1959, and 1.9 percent in 1960, respectively (Table 11).

The decline in economic growth was attributed mainly to the gradual reduction of foreign aid to Korea. In fact, during the period the Korean economy was dependent upon U.S. grant aid. Almost all raw materials, consumer goods, imported grains and foodstuff supplied in the nation were purchased with U.S. grant aid funds.

TABLE 11

Annual Growth Rate of Major Sectors
1954 to 1960

(1970 Constant Prices)				
Year	GNP	Agriculture, Forestry and Fishing	Mining and Manufacturing	Social Overhead Capital and Services
1954	5.5 %	7.6 %	11.2 %	2.5 %
1955	5.4	2.6	21.6	5.7
1956	0.4	-5.9	16.2	4.0
1957	7.7	9.1	4.7	5.8
1958	5.2	6.2	8.2	3.5
1959	3.9	-1.2	9.4	7.5
1960	1.9	-1.3	10.4	2.8

Source: Bank of Korea, Economic Statistics Yearbook, 1973.

B. GENERAL GROWTH OF ECONOMY AND FIVE YEAR PLANS

Since 1961 the government has managed the economy as an integral and vital part of a garrison state. From 1961 to 1976, the government had successfully established First, Second and Third Five-Year Economic Plans (1962-1966, 1967-1971, 1972-1976). The First Five Year Plan

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(1962-1966) adopted an "unbalanced" approach to economic growth and laid down a philosophy of development keyed to industrialization. The overall strategy was to concentrate on three key, or leading, sectors: electric power, agriculture and "social overhead capital." The expansion of hydroelectric and thermal power capacity, including an increasing output of coal for fuel, was intended to provide the basis for an expansion of key industrial production. The aim of expanding agricultural output was to achieve self-sufficiency in food grain production and consumption by 1966. The expansion of social overhead capital envisioned concentration on the use of unemployed and under-employed rural labor to build roads, multipurpose dams, and urban public works [19].

Under the first plan, economic progress surpassed most planned goals in all sectors except agriculture. Consequently, a substantial increase in national and per capita incomes was achieved. The Gross National Product (GNP) showed an actual increase of about 8 percent in real terms. The population grew by less than had been anticipated, so that actual increases in GNP per capita from $87 (U.S.) to $126 (U.S.) and in private consumption per capita were higher than expected. The realized export was increased from $54 million (U.S.) in 1962 to $250 million (U.S.) in 1966. This export level was nearly double the goal level (see Figure 1).

The most important aspects of economic development under the first plan was the growth of mining and manufacturing at an average annual rate of 14.1 percent, social overhead capital and services 8.3 percent, with agriculture (including forestry and fisheries) reaching only 5.1 percent (see Table III).

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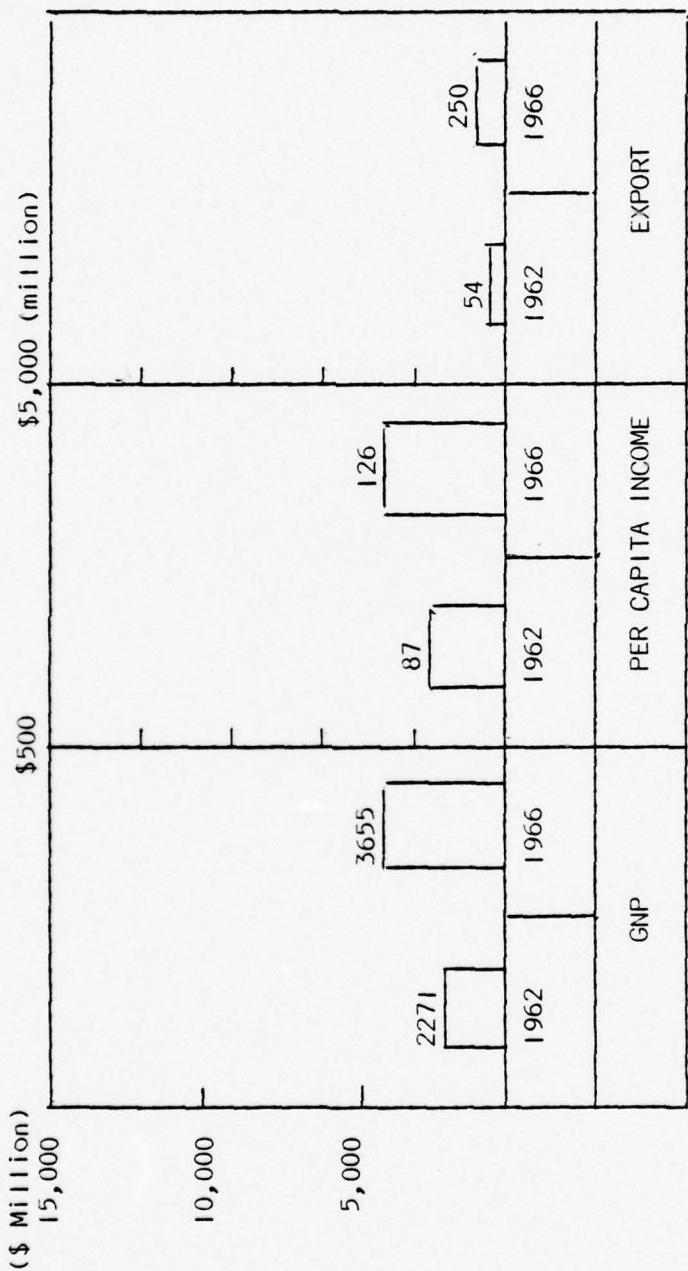
Figure 1. First Five Year Plan

Source: EPB, Major Statistics of Korean Economy, 1977.

TABLE III

ANNUAL GROWTH RATE OF MAJOR SECTORS (AS CUMULATIVE GROWTH RATE)
1970 CONSTANT MARKET PRICES

YEAR	GNP	Agriculture, Forestry and Fisheries	Mining and Manufactures	Social Overhead Capital and Services
1961	4.8	11.9	3.6	-1.1
1962	3.1	-5.8	14.1	8.9
1963	8.8	8.1	15.7	7.4
1964	8.6	15.5	6.9	3.0
1965	6.1	-1.9	18.7	9.9
1966	12.4	10.8	15.6	12.6
1967	7.8	-5.0	21.6	13.8
1968	12.6	2.4	24.8	15.4
1969	15.0	12.5	19.9	14.6
1970	7.9	-0.9	18.2	8.9
1971	9.2	3.3	16.9	8.9
1972	7.0	1.7	15.0	5.8
1973	16.7	3.6	30.4	14.6
1974	8.7	5.8	17.0	4.9
1975	8.3	7.1	12.9	5.8
1976	15.3	8.3	25.1	11.3
AVERAGE				
1962-66	7.7	5.1	14.1	8.3
1967-71	10.5	2.3	20.2	12.3
1972-76	11.0	5.3	19.9	8.4
1962-76	9.7	4.2	18.1	9.7

Source: EPB, Major Statistics of Korean Economy, 1977

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The Second Five Year Plan (1967 - 71) was essentially a medium-
term plan, presented as the next stage in meeting long-range goals.
It called for annual overall resources budgets which were to be the
basic instruments for translating plans into action. These budgets
would review progress sector by sector, allocate the overall govern-
ment fiscal budget, and devise monetary, fiscal, and trade policies
consistent with the plan's longer run goals. Basic objectives of the
second plan were virtually the same as those of the earlier plans.
Strategies to achieve these goals emphasized rapid expansion of exports,
increased mobilization of capital, efficient utilization of manpower,
and continuing financial stability [19].

By the end of the second plan, GNP had registered an annual average
increase of 10.5 percent in real terms (see Figure 2), and per capita
GNP had doubled. The high rate of growth had been led by mining-manu-
facturing which increased the annual average 20 percent (see Table III).
During the second Five Year Plan period, the nation's commodity exports
which stood at $335 million (U.S.) in 1967, advanced to $1,132 million
(U.S.) in 1971 (see Figure 3).

During the first and second Five Year Plans, the nation had achieved
a fairly high rate of growth in real terms. Following the successful
implementation of the past plans, the third such plan was launched in
1972. During the Third Five Year Economic Development plan period
(1972-76), the nation's economy was planned to grow at an average rate
of 8.6 percent and per capita GNP was forecast to go up 52 percent.

The Third Five Year Development Plan can be characterized by its
attempt to promote a "balanced economy" by 'expanding regional develop-
ment', 'developing and improving life in rural areas', and 'improving

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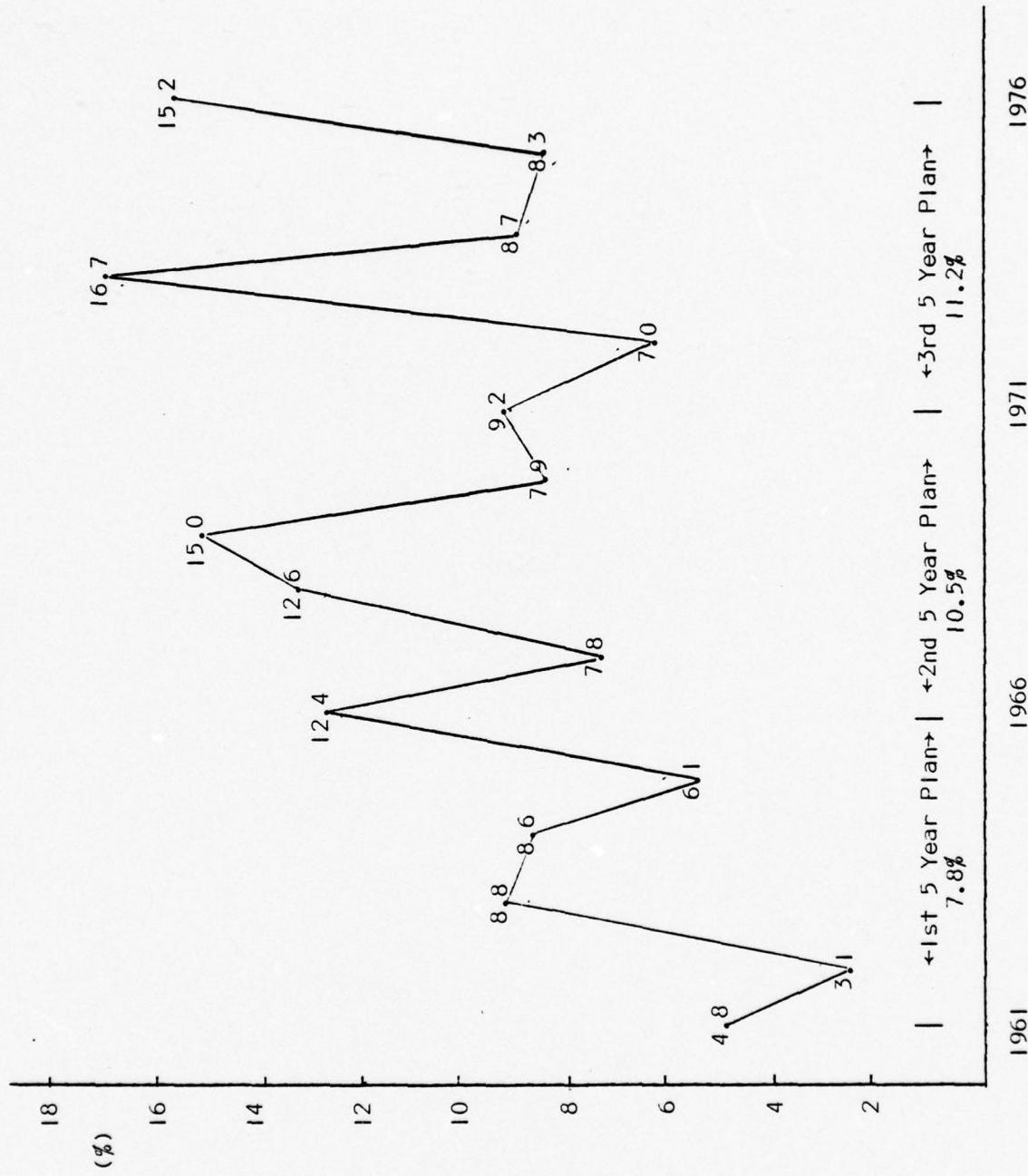
Figure 2. Trend of Economic Growth Rate
Source: EPB, Major Statistics of Korean Economy, 1977.

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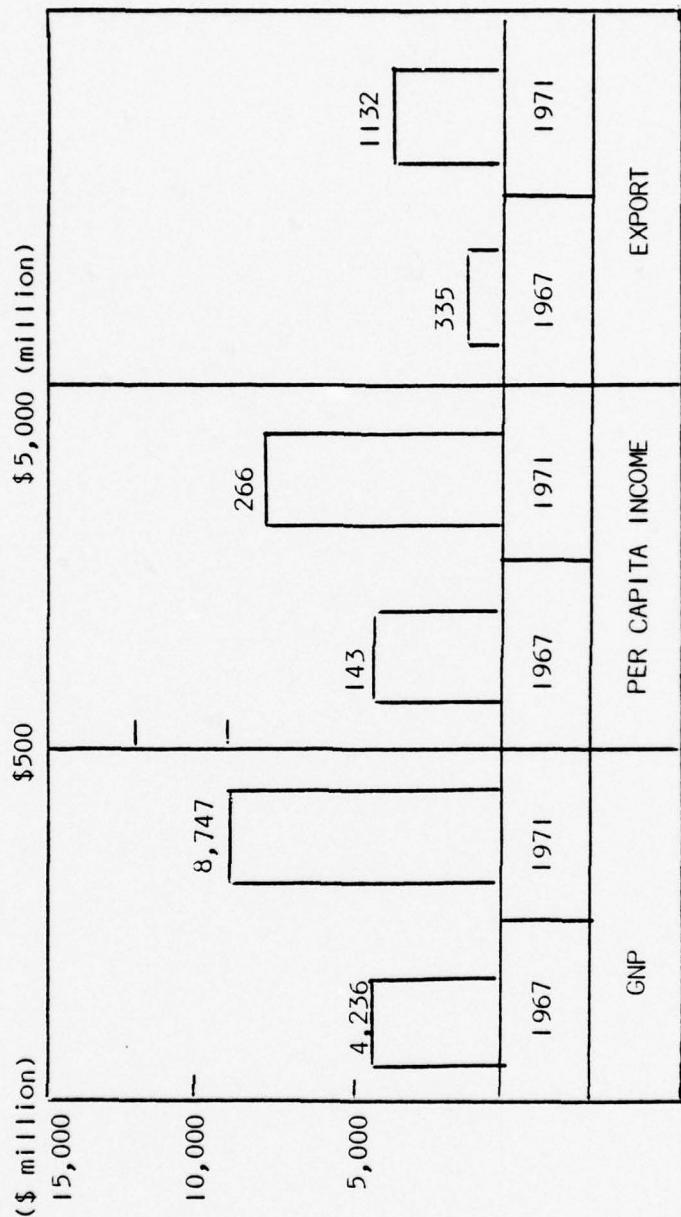
Figure 3. Second Five Year Plan

Source: EPB, Major Statistics of Korean Economy, 1977.

the quality of the life of workers' [13]. These goals are sufficiently vague but suggest a shift in emphasis from building an industrial base and modernizing the industrial structure to rural development and re-distributive programs. Prominently, the Third Five Year Plan targets include achievement of self-sufficiency in food grains, raising of commodity exports to $3.5 billion (U.S.) by 1976, construction of heavy and chemical industries, and promotion of "balanced regional development" [21].

At the end of this plan, the nation achieved an annual average growth of GNP of 11 percent in real terms which exceeded by 2.4 percent the plan's target. The per capita GNP reached from $293 (U.S.) in 1972 to $698 in 1976, which was more than 4 times the target amount. The mining-manufacturing increased an average annual 20 percent, and exports reached from $1,676 million (U.S.) in 1972 to $7,815 in 1976. This was an average annual growth of 31 percent and more than 2 times the target plan. Self-sufficiency in food production, agriculture-forestry and fisheries, was only 5.3 percent of the average annual growth which indicated below self-sufficiency levels.
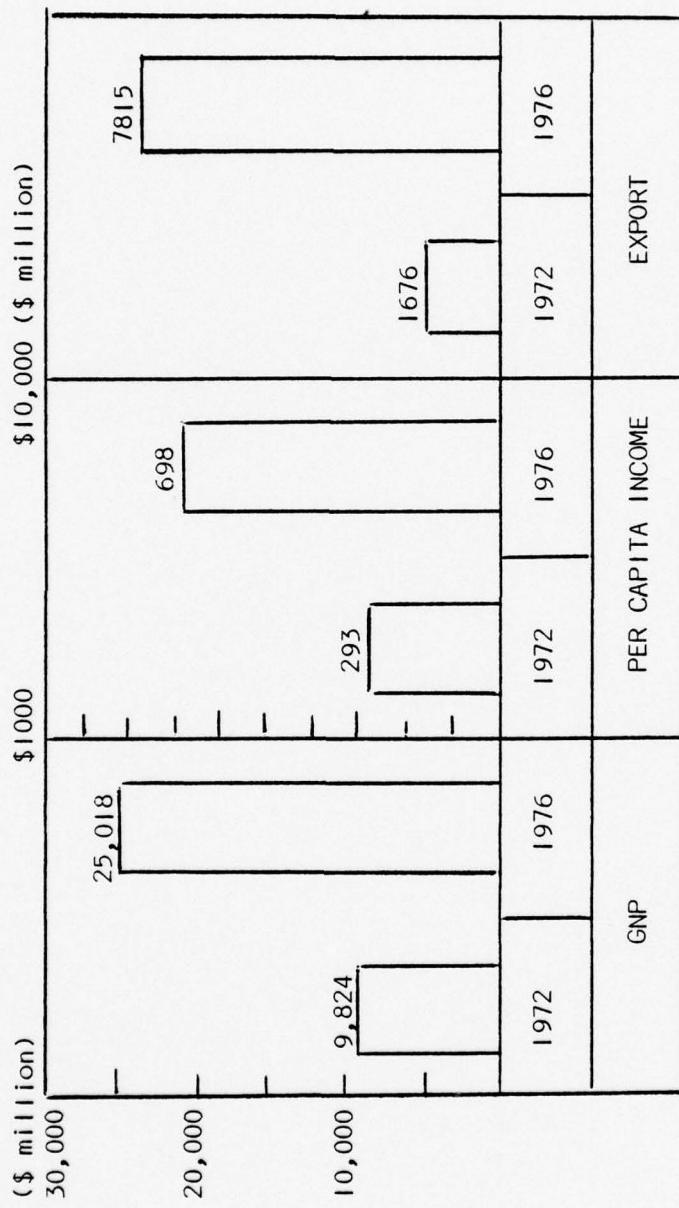
Figure 4. Third Five Year Plan

Source: EPB, Major Statistics of Korean Economy, 1977.

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C.   GROWTH RATE AND STRUCTURAL CHANGES

   1.   General Trends of Structural Patterns

       The marked shift in the pace of economic growth that took place
during this period (1961-1976) was accompanied by broad changes in
economic structure.

       In the early 1960s the primary sector of the economy (including
agriculture, forestry, and fisheries) generated approximately 40 percent
of the GNP and absorbed 63 percent of the labor force (see Table IV).
In the same period the secondary sector (including manufacturing indus-
tries and mining) provided a sharp contrast. This sector produced about
14 percent of the GNP with a little less than 9 percent of the labor
force. The social overhead capital and other services composed of con-
struction, electricity, water, sanitary services, transportation, stor-
age, communication and others, generated about 46 percent of the GNP and
employed a little over 28 percent of the labor force. In 1976, accord-
ing to the final national accounts for that year, the contribution of
the primary sector to the GNP fell to about 20 percent, and the manu-
facturing and mining sector rose to 36 percent. The social overhead
capital and other services contributed almost the same to the GNP.

       Meanwhile, the employed labor force decreased to 45 percent in
the primary sector, increased about 22 percent in the secondary sector
and the social overhead capital-other services changed only from 28 per-
cent to 34 percent.

       These changes continued a trend during the period of marked
changes in employment patterns and in sector contributions to the GNP,
especially in favor of manufacturing and supporting elements of the
economy. The greater importance of the secondary sector had occurred

to some extent because of a spontaneous move toward industrialization and the high rate of growth of the secondary sector leading to an increase in its relative weight which, in turn, is likely to have a decisive influence on the aggregate rate of growth.

The structure change in the economy has profound implications for future growth rates.

TABLE IV

Change in percent of industrial origin of GNP and labor force by economic sector. (1970 constant market prices)

Sector	1963		1976	
	GNP	Labor force	GNP	Labor force
Agri., Forestry and Fisheries	40.0	63.1	20.3	44.6
Manufacturing and mining	14.1	8.7	36.0	21.9
Social overhead capital and others	45.9	28.2	43.7	33.5
Total	100.0	100.0	100.0	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

2. Expenditure on Gross National Product

Estimates for the main expenditure categories and their percentage shares are presented in Table V. Gross national product is used rather than domestic product because it includes net factor income from the rest of the world that is spent in Korea though originating elsewhere [21]. The estimates show substantial acceleration in the growth of all

TABLE V. Gross National Product Expenditures (percent of GNP)
(1970 constant market prices, in billion won)

	1961		1966		1971		1976	
	amt.	% share	amt.	% share	amt.	% share	amt.	% share
Private consumption	950.7	80.3	1282.4	74.6	2080.1	73.6	2871.1	60.3
Government consumption	163.4	13.8	200.3	11.7	311.9	11.0	474.0	10.0
Gross domestic capital formation	121.4	10.2	317.5	18.4	748.8	26.5	1288.3	27.1
Exports	38.2	3.2	122.3	7.1	459.4	16.3	1645.9	34.6
Less imports	106.6	9.0	237.9	13.8	773.6	27.4	1397.8	29.4
Trade balance (exports-imports)	(-68.4)	(-5.8)	(-15.6)	(-6.7)	(-314.2)	(-11.1)	(248.1)	(5.2)
Statistical discrepancy	10.7	0.9	19.4	1.1	2.2	0.1	-85.6	-1.8
GDP	1177.7	99.4	1703.9	99.1	2828.8	100.1	4795.8	100.8
Net income from rest of world	6.8	0.6	15.3	0.9	-2.0	-0.1	-38.2	-0.8
GNP	1184.5	100.0	1719.2	100.0	2826.8	100.0	4757.7	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

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types of expenditure and unusually high growth rates during the period (1961-76) for investment (gross domestic capital formation), export, and imports. The shares of both private and government consumption declined as a growing portion of the national product were allocated to investment and exports. Exports expanded more rapidly but were still substantially smaller than imports until the early 1970s. After approximately 1974, the imbalance of trade changed to a positive quantity and at the end of 1976, exports (goods and services) exceeded about 248 billion won.

The use of the gross national product show changes that can be described only as radical particularly because they occurred during the 1970's. Dependence on imports increased while a larger share of domestic product was exported. Foreign trade was, therefore, much more important for the Korean economy by the 1970s than it had been during the earlier period. The chief finding is a major shift in expenditure from consumption to investment as the growth of domestic products accelerated. Consumption, both private and government, rose absolutely but considerably less than it might have. An increasing share of a rapidly growing total became available for investing in new capacity or otherwise was available to generate greater future consumption.

3. Private Consumption

Private consumption expenditures in 1976 totaled 2871.1 billion won at 1970 constant market prices, a real rise of 38 percent over 1971. During this last five year period the share of GNP declined from 73.6 percent in 1971 to 60.3 percent in 1976.

Private consumption distributed by major type of expenditure is given in Table VI. Food accounted for over half of the total during

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the 1960s, but less than half by the 1970s. It is indicated that food
and other basic necessities still make up a larger fraction of consumer
expenditures in Korea than in other developed countries.

TABLE VI

Private Consumption
(1970 constant market prices, in % share)

	Food	Beverages and Tobacco	Clothing	Housing	Services	Total
1961	58.0	6.1	10.2	12.5	13.2	100.0
1966	55.1	6.0	9.4	13.2	16.3	100.0
1971	47.0	9.6	12.3	12.1	19.0	100.0
1976	43.6	10.2	13.3	13.7	19.2	100.0

Source: BOK Economic Statistics Yearbook, 1977

4. Government Consumption

Government consumption grew least among the expenditure cate-
gories shown in Table V and the share of GNP declined from 13.8 percent
to 10.0 percent during the period (1961-76). Consumption by economic-
functional category is given in Table VII for selected years. It shows
that consumer expenditures on research, education, health, and welfare
grew during the last decade (1961-71) but after the middle 1970s
began to decline in terms of the share of GNP, during which time the
defense expenditure increased.

The changing patterns of government consumption were influenced
by United States military assistance which declined after 1974. It

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indicates that larger portions of government expenditures are for defense.

TABLE VII

Government Consumption by Economic-
Functional Category (%)

	1961	1971	1976
Consumer	19.7	22.8	19.6
Research, education	12.6	16.5	13.3
health, welfare	7.1	6.3	6.3
Economic	48.1	42.7	36.6
Gen. admin.	15.1	11.5	3.8
other economic	33.0	31.2	32.4
Others	5.2	12.0	11.4
Defense	27.0	22.5	32.4
Total	100.0	100.0	100.0

Source: BOK, Economic Statistics Yearbook, 1973 and 1977.

5. Investment

Gross domestic capital formation grew slowly and the share of GNP during the period (1961-76) showed an annual average 22 percent of GNP for investment, high by international standards [21]. Actually, investment had doubled at the end of 1976 (see Table VIII). This increase in investment with its multiplier effects, capacity creation, employment, and productivity consequences was an important cause of economic development during the period. The growth of fixed capital formation from the selected years during the period and change in its distribution by type or sector are shown in Table IX.

Table VIII. Use of Resource (percent of GNP)
(1970 constant market prices)

| | CONSUMPTION EXPENDITURE | | |
YEAR	PRIVATE	PUBLIC	GROSS CAPITAL FORMATION
1961	82.6	13.5	13.1
1962	84.2	14.2	13.0
1963	82.5	11.2	18.5
1964	83.8	8.9	14.6
1965	83.1	9.4	15.1
1966	78.0	10.2	21.7
1967	77.0	10.4	22.1
1968	75.4	11.0	26.8
1969	71.8	10.7	25.8
1970	72.8	10.9	27.2
1971	74.2	11.3	25.6
1972	73.7	11.3	20.9
1973	68.1	9.8	26.3
1974	69.7	11.0	31.2
1975	70.8	11.2	27.3
1976	65.7	12.9	25.0

Source: EPB, Major Statistics of Korean Economy, 1977.

Table IX. Gross Domestic Fixed Capital Formation
(1970 constant market prices, in billion won)

by Type	1961		1966		1971		1976	
	amt.	%	amt.	%	amt.	%	amt.	%
Dwelling	18.5	17.7	35.6	12.1	96.1	14.1	155.4	12.7
Non-residential bldg.	20.1	19.2	59.5	20.2	129.5	19.0	217.0	17.7
Other construction	31.9	30.5	79.5	27.0	181.3	26.6	319.7	26.1
Transport equipment	11.1	10.6	36.4	12.4	115.0	16.9	222.7	18.2
Machinery, other equipment	23.0	22.0	83.2	28.3	158.8	23.4	310.0	25.3
TOTAL	104.6	100.0	294.2	100.0	680.7	100.0	1224.8	100.0

by Sector	1961		1966		1971		1976	
	amt.	%	amt.	%	amt.	%	amt.	%
Agriculture	14.3	13.7	35.1	11.9	55.8	8.2	129.7	10.6
Mining and manufacturing	21.1	20.2	86.4	29.4	136.8	20.1	277.0	22.6
Services	69.2	66.1	172.7	58.7	488.1	71.7	818.1	66.8
TOTAL	104.6	100.0	294.2	100.0	680.7	100.0	1224.8	100.0

Source: BOK, Economic Statistics Yearbook, 1977.

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Shares of dwelling and of non-residential buildings in total fixed capital formation declined through the period and were affected by investment in transport equipment, machinery, and other equipment.

Grouping investment by sector shows that the mining and manufacturing sector received a large portion of investment in the 1960's, and again after the middle 1970s. Agriculture's share has been a small and relatively constant 10 percent level of the total investment. Agriculture's small investment share may also reflect the top priority given to other sector investment during the Five-Year Plans.

D. FOREIGN ECONOMIC RELATIONS

Foreign economic relations were of fundamental importance to the economy as a whole and were closely interwoven with the country's economic performance. Shifts in the structure and financing of foreign trade have been among the most notable changes in the Korean economy and have had a major influence on the whole development pattern.

The rapid industrial growth of the late 1960s and early 1970s depend on the development of export markets, and changes in foreign trade. Because of the country's close links to the industrial nations of the noncommunist world, its economy tended to fluctuate with the swings in economic conditions in those nations [19]. In 1976 the country's foreign economic relations continued to be dominated by Japan and the United States. These two countries were major export markets and suppliers.

1. Exports

The country's major exports are manufactured goods. This included goods manufactured from imported raw materials and semifinished imports, manufactured machinery and, notably, electronic products and light industrial goods. By 1976, 90 percent were manufactured products

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and only 10 percent were primary products. Total exports were $7,814.6 million (U.S.) which expanded more than 190 times between 1961 and 1976, a rate of growth averaging more than 40 percent per annum (see Table X).

The largest market for Korean export in the early 1960s was Japan, and from the middle of the 1960s onward the most important has been the United States (see Table XI). Both countries have absorbed more than 50 percent of Korean's exports. The remaining exports are also split between various Asian, European, and Middle East countries.

2. Imports

The country's major imports were raw materials, and intermediate goods that entered into the production of other goods for exports and for domestic use. By 1976, 53 percent were raw materials and 28 percent were capital goods.

The most notable change in import composition has been the steady rise in capital goods, which significantly decreased raw materials for domestic uses, which, by the early 1960's accounted for 80 percent of the total imports. During 1976, this percentage was only 26 (see Table XII). A most important fact is that raw materials for exports was zero in the early 1960s, but rapidly increased from the middle 1960's. An annual average of 27 percent was imported in the 1970's period.

The largest supplier of Korean imports in the middle 1960s was the U.S.A. This shifted to Japan in 1966. In 1976, Korea imported 22.4 percent from the U.S.A. and 35.3 percent from Japan (see Table XIV).

3. Foreign Aid, Loan, and Investment

During the period, the external resources inflow pattern was obviously changed. Official economic aid, which was composed with

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Table X. Annual Growth Rate of Exports and Imports

(U. S. $ million)

Year	Exports		Imports	
	Amt.	Growth rate	Amt.	Growth rate
1961	40.9	24.7	283.1	-7.3
1962	54.8	34.0	390.1	37.8
1963	86.8	58.4	497.0	27.4
1964	119.2	37.3	364.9	-26.6
1965	175.1	46.9	415.9	14.0
1966	250.3	42.9	679.9	63.5
1967	334.7	33.7	908.9	33.7
1968	486.2	43.3	1322.0	45.5
1969	658.3	35.4	1650.0	24.8
1970	882.2	34.0	1804.2	9.3
1971	1132.3	28.3	2178.2	20.7
1972	1675.9	48.0	2250.4	3.3
1973	3270.8	95.2	3837.3	70.5
1974	4515.1	38.0	6451.9	68.1
1975	5003.0	10.8	6674.4	3.4
1976	7814.6	56.2	8226.5	23.3

Source: EPB, Major Statistics of Korean Economy, 1977.

Note: Based on balance of payment.

Table XI. Composition of Exports Market by Major Country (percentage)

1961 to 1976

Year	U.S.A.	Japan	Other Asia	Europe	Others	Total
1961	16.6	47.4	19.3	5.8	21.3	100.0
1962	21.9	42.9	11.2	3.3	20.7	100.0
1963	28.0	28.6	11.3	3.3	28.8	100.0
1964	29.9	32.1	11.4	6.4	20.2	100.0
1965	35.2	25.1	7.4	3.9	28.4	100.0
1966	38.3	26.5	4.9	4.8	25.5	100.0
1967	42.9	26.5	6.1	4.1	20.4	100.0
1968	51.7	21.9	4.9	3.6	17.9	100.0
1969	50.1	21.4	6.3	4.3	17.9	100.0
1970	47.3	28.1	4.5	4.9	15.2	100.0
1971	49.8	24.5	5.8	4.2	15.7	100.0
1972	46.7	25.1	6.8	5.0	16.4	100.0
1973	31.7	38.5	5.9	6.0	17.9	100.0
1974	33.5	30.9	5.7	7.8	22.1	100.0
1975	30.2	25.5	5.8	9.3	29.2	100.0
1976	32.3	23.4	5.9	8.5	29.9	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

Table XII. Imports by Type of Goods (Percentage)
1961 to 1976

	Capital Goods	Raw Materials for Exports	Raw Materials for Domestic Uses	Petroleum	Total
1961	13.4	-	86.6	-	100.0
1962	16.5	-	76.7	6.7	100.0
1963	20.6	-	75.2	4.2	100.0
1964	17.2	1.7	74.7	6.4	100.0
1965	12.9	2.2	78.6	6.2	100.0
1966	24.0	14.1	56.2	5.7	100.0
1967	31.1	13.6	49.3	6.0	100.0
1968	36.4	14.6	44.0	5.0	100.0
1969	32.5	16.3	45.3	5.9	100.0
1970	29.7	19.5	44.1	6.7	100.0
1971	28.6	21.1	42.4	7.9	100.0
1972	30.2	27.3	33.9	8.6	100.0
1973	27.4	26.7	38.9	7.0	100.0
1974	27.0	29.8	28.3	14.9	100.0
1975	26.3	30.0	25.4	18.3	100.0
1976	27.7	27.4	26.0	18.9	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

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Table XIII. Percentage of Exports by Products
1961 to 1976

Year	Agricultural Products	Marine Products	Mining Products	Manufactured Goods	Total
1961	21.9	17.7	42.2	18.2	100.0
1962	23.0	22.0	28.0	27.0	100.0
1963	13.3	15.5	19.5	51.7	100.0
1964	10.4	19.9	18.1	51.6	100.0
1965	8.7	13.7	15.3	62.3	100.0
1966	9.5	14.7	13.4	62.4	100.0
1967	4.7	14.7	10.5	70.1	100.0
1968	4.3	10.2	8.2	77.3	100.0
1969	4.2	9.4	7.4	79.0	100.0
1970	3.0	8.2	5.2	83.6	100.0
1971	2.8	7.7	3.5	86.0	100.0
1972	2.9	7.6	1.8	87.7	100.0
1973	3.1	7.2	1.5	88.2	100.0
1974	2.8	5.3	1.7	90.2	100.0
1976	2.7	6.4	1.1	89.8	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

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Table XIV. Composition of Import Market by Major Country
(percentage)

Year	U.S.A.	Japan	Other Asia	Europe	Others	Total
1961	45.4	21.9	2.1	9.5	21.1	100.0
1962	52.2	25.9	1.8	6.1	14.0	100.0
1963	50.7	28.4	4.0	5.0	11.9	100.0
1964	50.0	27.2	2.8	6.7	13.3	100.0
1965	39.3	36.0	3.9	3.8	17.0	100.0
1966	35.4	41.0	2.8	3.1	17.7	100.0
1967	30.6	44.5	4.0	3.6	18.3	100.0
1968	30.7	42.7	2.5	6.1	18.0	100.0
1969	29.1	41.3	3.2	6.1	20.3	100.0
1970	29.5	40.8	3.7	5.1	20.1	100.0
1971	28.3	39.8	4.1	5.4	22.4	100.0
1972	25.7	40.9	5.8	5.6	22.0	100.0
1973	28.3	40.7	5.6	4.7	20.5	100.0
1974	24.8	38.3	5.4	3.4	29.2	100.0
1975	25.9	33.5	4.5	4.3	31.8	100.0
1976	22.4	35.3	4.0	4.7	33.6	100.0

Source: EPB, Major Statistics of Korean Economy, 1977.

Public Law 480 and Agency for International Development (AID) from the U.S.A., was changed from $200 million in 1961, to only $1.7 million in 1976. Otherwise, loan and foreign investment, which started in 1962, accelerated (see Table XV). These implicated that the Korean economy changed from depending on foreign aid economy to self-sufficiency, thereby, expanding the domestic economic pattern.

E. THE DEFENSE AND THE ECONOMY

Since the outbreak of the Korean War the Korean peninsula remained one of the world's most heavily armed regions. The active armed forces of Korea in 1976 totaled over 600,000 officers and men. The great majority of these were in the army (more than 500,000 men), the sixth largest ground force in the world [19].

The direct and indirect impact of the military establishment on the economic life of Korea since the Korean war was and is very great. Both the size of the standing armed forces and the amount and sophistication of the armament were, before the 1970s at least, beyond the capacity of the nation's economic base to sustain without United States military assistance.

Defense expenditures accounted for about 32.4 percent of the nation's budget in 1976; during the period (1961-76) annual average defense expenditure was 27.5 percent of the budget and 4.4 percent of GNP (see Figure 5). Budgeting expenditures represented only a portion of the total economic cost of the military establishment. Defense expenditures did not include contribution to the defense forces and the defense-related inflow structure through the Military Assistance Program (MAP) and other forms of United States military-related assistance. The economic impact of such assistance could not be isolated and quantified.

Table XV. Economic External Resources

YEAR	U.S. MILLION $				CONVERTED TO BILLION OF 1970 WON				
	OFFICIAL AID	LOAN	FOREIGN INVESTMENT	TOTAL	OFFICIAL AID	LOAN	FOREIGN INVESTMENT	TOTAL	% OF GNP
1961	199.3	-	-	199.3	61.9	-	-	61.9	5.2
1962	232.3	4.5	5.4	242.2	72.2	1.4	1.7	75.0	6.1
1963	216.5	52.1	5.5	274.1	67.2	16.2	1.7	85.1	6.4
1964	149.3	34.6	0.6	184.5	46.4	10.7	0.2	57.3	4.0
1965	131.4	31.5	6.3	169.2	40.8	9.8	2.0	52.6	3.4
1966	103.3	108.4	14.5	226.2	32.0	33.7	4.5	70.2	4.1
1967	97.0	167.3	13.9	490.5	30.1	52.0	4.3	86.4	4.7
1968	105.9	299.7	13.5	419.1	32.6	93.1	4.2	129.9	6.2
1969	107.3	475.7	37.5	620.5	33.3	147.5	11.6	192.4	5.4
1970	82.6	400.2	58.9	541.7	25.7	124.3	18.3	168.3	6.5
1971	51.2	541.4	32.9	625.5	15.9	168.2	10.2	194.3	6.9
1972	5.1	628.7	125.0	758.8	1.6	195.3	38.8	235.7	7.8
1973	2.2	628.4	268.3	898.9	0.7	195.2	83.3	279.2	8.0
1974	1.0	638.8	120.7	760.5	0.3	198.4	37.5	236.2	1.4
1975	1.2	886.7	199.6	1087.5	0.4	275.4	62.0	337.8	8.2
1976	1.7	898.4	65.1	965.2	0.5	279.0	20.2	299.7	6.3

Source: BOK, Economic Statistic Yearbook, 1973 and 1974.
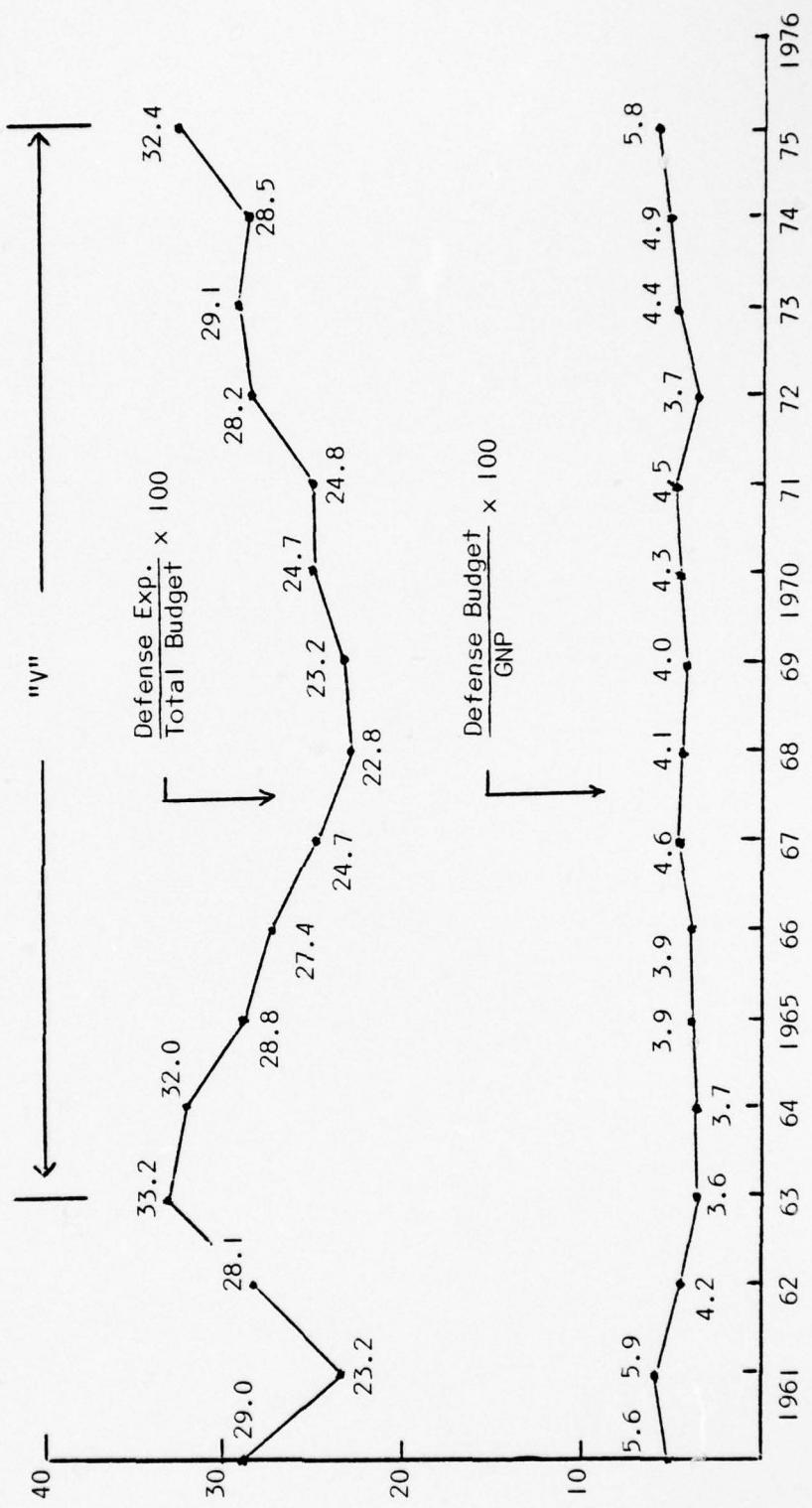
Figure 5. Trends of Defense Budget

Source: EPB, Major Statistics of Korean Economy, 1977

In Figure 5 it is shown that the defense budget peaked by 33.2 percent in 1964, and gradually decreased to 22.8 percent in 1969. From this point the defense budget increased again, and hit 32.4 percent in 1976. One of the important properties of the defense budget was this "V shape" (1964-1976) which has a highly negative correlation with United States military assistance. In 1964, military assistance was notably dropped and from the early 1970s gradually decreased (see Table XVI). These implied that the portion of decreasing military assistance had to be borne by the nation's budget. This increasing defense burden affected the nation's other economic activities.

Some of the positive fiscal impact was the direct involvement of the military elite and military institutions in the nation's economic life. Managerial and technical orientation were emphasized on economic development and focused considerable productive energies of the nation's successful five-year plans. Large numbers of officers and servicemen entered both the private and the public sectors when they finished their duty services in military, with their managerial and technical skills as civilian-related skills stemming from their training in military. Also, under the civic action program promoted by the military, soldiers built and repaired roads, dams, and schools. Transportation and equipment were provided to meet the local needs. One of the most important facts was the general policy to use the armed forces and military facilities for disaster assistance and in large public projects such as flood control. These activities had an important and usually beneficial effect on the nation's economic life.

Table XVI. U.S. Military Assistance

Year	In Million U.S.$	Converted Billion 1970 Won	Percent of GNP
1961	192.2	59.7	5.0
1962	136.9	42.5	3.5
1963	173.8	54.0	4.1
1964	124.4	38.6	2.7
1965	173.1	53.8	3.5
1966	161.8	50.3	2.9
1967	169.4	52.6	2.8
1968	253.4	78.7	3.8
1969	137.9	42.8	1.8
1970	136.6	42.4	1.6
1971	293.2	74.3	2.6
1972	155.8	48.4	1.6
1973	149.1	46.3	1.3
1974	94.0	29.2	0.7
1975	82.6	25.7	0.6
1976	62.4	19.4	0.4

Source: a. Data Management Division, Comptroller, DSAA
Foreign Military Sales and Military Assistance Facts,
1975 and 1976 (Column 2. 1966 to 1976).
         b. U.S. Overseas Loans and Grants: Special Report Prepared
for the House Foreign Affairs Committee
(Column 2. 1961 to 1965, Reference 10, p. 250).

III. STATISTICAL AND ECONOMIC ANALYSIS BETWEEN DEFENSE BURDEN AND GROWTH RATE FACTORS

A. METHOD AND CONCEPTS

This chapter deals with the relationship between the defense burden and the major economic growth factors by using the statistical and economic analysis based on the 16 year observed period. This analysis was conducted using Spearman correlation, and regression analysis in the SPSS package as well as multiple regression equations. A confidence interval of 95 percent ($\alpha = 5\%$ level) and F value were used.

1. Correlation Analysis

Correlation coefficient indicates the degree to which variation (or change) in one variable is related to variation (change) in another. A correlation coefficient not only summarizes the strength of association between a pair of variables, but also provides an easy means for comparing the strength of relationship between one pair of variables and a different pair [20].

Mathematically, the value of the coefficient may range from a perfect positive correlation (+1.0), through no relationship (0.0), to a perfect negative correlation (-1.0). However, the interpretation of the value of a correlation coefficient is purely relative to the circumstances under which it was obtained and should be interpreted in the light of those circumstances.

2. Regression Analysis

The correlation coefficient is a useful index for evaluating the correlation between the variables, but this information cannot give

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a clear prediction. Regression analysis is a statistical tool which uses the relation between two or more quantitative variables so that one variable can be predicted from the other or others. For example, in simple regression analysis, values of the dependent variable are predicted from a linear function of the form,

$$Y = A + BX$$

where

y = the estimated value of the dependent variable Y

B = constant by which all values of the independent variable X are multiplied

A = constant which is added to each case

$$\text{Residual} = Y - Y'$$

$$\Sigma(Y - Y')^2 = SS_{res} = \text{minimum}$$

(The sum of squared residuals is smaller than any possible alternative values.)

It can be shown that the optimum values for B and A are obtained from the following formulas [17]:

$$B = \frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{\Sigma(X - \bar{X})^2}$$

$$A = \bar{Y} - B\bar{X}$$

Through the use of regression analysis, we can predict an unknown variable Y' when the value of another variable X is known.

B. SIMPLE REGRESSION ANALYSIS

    1. Defense and Growth Rate of Gross National Product

        An overview of the changing level of defense expenditure as a portion of the GNP (defense burden) was the average annual 4.4 percent

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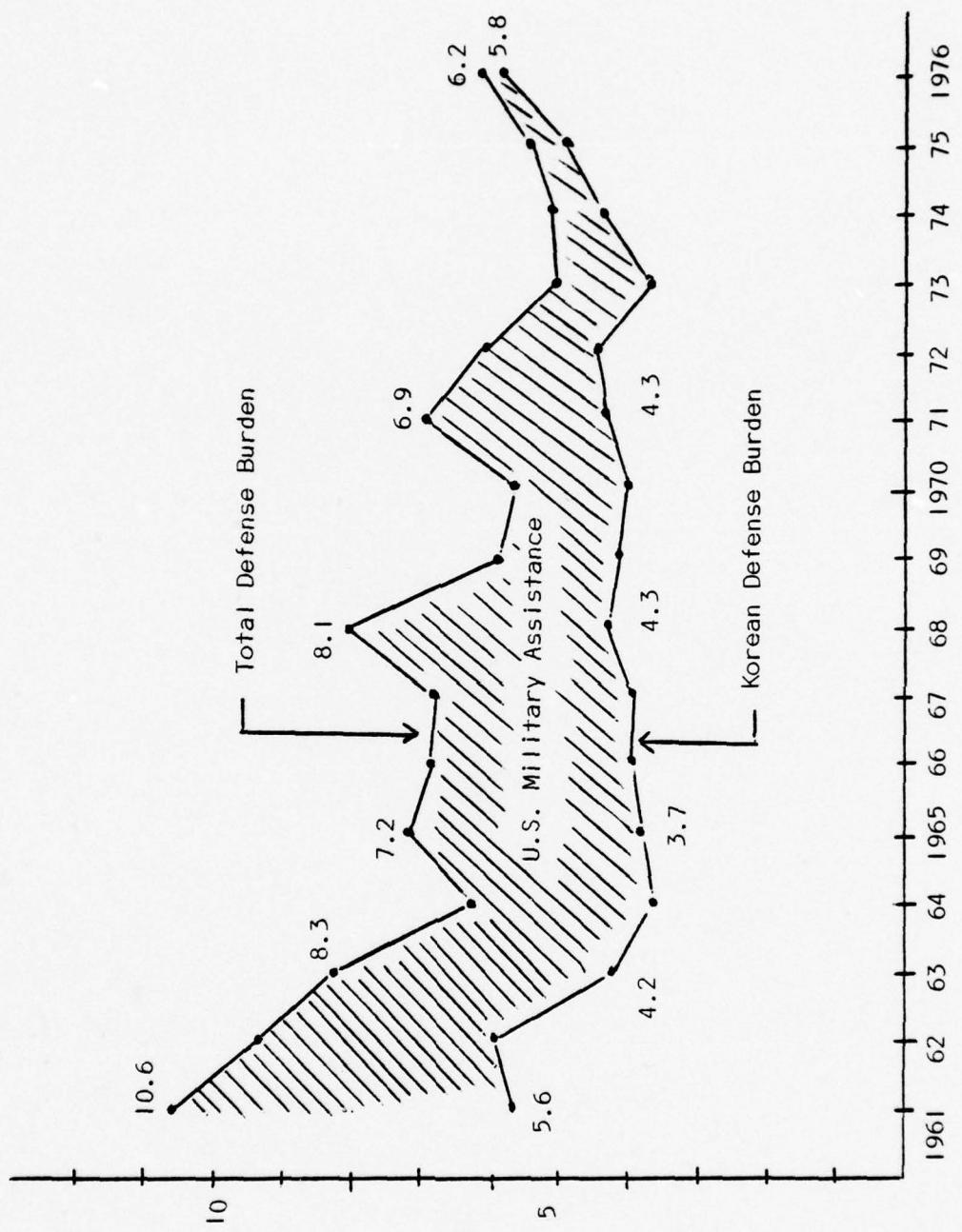
Figure 6. Defense Burden (% of GNP)

from this observed period (1961-1976). Actually the nation's defense

burden is more than this amount, because the United States military

assistance was spent for the nation's defense purpose. When the author

attempted regression analysis, the correlation coefficient between de-

fense burden and growth rate of GNP was too weak (0.27) and also was

statistically not significant at the 5% level. It was found that the

nation's defense expenditure was not only dependent on GNP growth,

but also United States military assistance.

During this period, military assistance was more than the aver-

age annual 2.4 percent of GNP when converted to the value of the Korean

Won in the 1970's. This percentage indicated that United States bore

more than half of the Korean defense burden during that period. It

has always been assumed that Korea would one day bear the whole defense

burden in her own budget. From 1969, military assistance obviously de-

creased. In 1976, the military assistance was only 0.4 percent of GNP.

From this fact the nations' future defense expenditure can be predicted

by statistical analysis. This can be accomplished by including in the

defense expenditure past military assistance portions. The growth rate

of GNP was a marked annual average 9.5 percent, for 1961 and 1962, and

then more than 10 percent cumulative growth rate. The Koren economy was

at the takeoff stage in 1963; during the period the GNP growth of 16.7

percent peaked in 1973.

When the defense burden included military assistance, the corre-

lation coefficient between defense expenditures and GNP was 0.9359

which was statistically significant at the 5% level, while the defense

burden and growth rate of GNP was -0.5226; a negative correlation which

was also statistically significant. The result can be written as a simple regression equation,

Defense burden = 8.87 - 0.5226 (Growth rate of GNP)

(DF: 1, 14. F value: 5.26)

These results suggest that Korea did not suffer a heavy rise in defense burden in comparison with the rapid growth rate of GNP, although the amount of defense spending increased. Changes in GNP are the major explanatory factor for all variables except military assistance and foreign economic aid; these having decreased relatively.

The relationship between defense expenditure and GNP was highly positively correlated, but defense burden to the growth rate of GNP was an inverse relationship.

2. Defense and the Investment Rate

Next to defense, an important factor is investment, the gross domestic capital formation as a percent of GNP. If defense expenditure diverts resources from investment, it should be found that an inverse relationship between defense expenditure and the investment rate exists.

The correlation coefficient between the defense burden and the investment rate was -0.7476. What this means is that Korea continued to shift more money to investment from defense spending or other resources. When compared with the other expenditures of GNP, the investment was highly negatively correlated to the government consumption expenditures; the correlation coefficient was -0.8508, and with private consumption expenditure was -0.8313 (see Appendix computer output).

Meanwhile, the relationship between growth rate of GNP and investment was a positive correlation of 0.6501, which indicated that

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the increasing investment rate positively affected the nation's economic growth. Above all, these correlations are statistically significant. Combining the results, it can be concluded that investment was the most dominant factor of the Korean economy.

3. Relation between Defense and Consumption Expenditure - Industrial Origin of GNP

The simple correlation between the defense burden and government consumption expenditures was 0.9042 and private consumption was 0.7277, of those that were significant. However, these two major consumption expenditures of GNP indicated that nation's consumption expenditures were changed by that period, and that portions of GNP were gradually decreased. This can be clearly explained from the relationship between the growth rate of GNP. The simple correlations of -0.6276 and -0.6459 showed them to be individually negatively correlated. These suggest that Korea spent more money for other sectors by increasing GNP growth.

The relationships between the defense expenditure and industrial origin of GNP were highly positively correlated, while to the defense burden, in terms of a portion of GNP, quite different relationships were shown.

Correlation between agriculture (including forestry-fisheries) and defense burden was 0.7289, -0.7109 for mining-manufacturing sectors. The social overhead capital-other services sector was too weak with an inverse correlation coefficient of -0.2473, which was not significant at 5% level.

From this industrial group analysis, it was concluded that this group obviously contributed to the GNP during the period. Except for the mining-manufacturing sector, the other two sectors did not contribute as

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strongly to the GNP growth. The defense burden was not affected signi-
ficantly by the mining-manufacturing sector.

4. Relation between Foreign Trade

A nation's international balance of payments is often a major
casualty of sharp increase in defense expenditures. The Korean situa-
tion is not unusual; some potential exports have been diverted to
satisfy internal demand. In 1976, Korea imported goods and services
were about 1,398 billion won (1970 constant market prices); while ex-
porting goods and services were 1.646 billion won. Over the period of
this survey, the correlation coefficient between them was 0.9679, which
was statistically significant. The simple correlation between defense
expenditure and these items was a highly positive relationship, 0.9352
for exports, 0.9263 for imports. On the whole, the defense burden and
these items in terms of portion of GNP were negatively correlated with
-0.6907 for exports and -0.7016 for imports. But the correlation be-
tween growth rate of GNP and these items was a positive relationship;
export was 0.5235, and import was 0.5578. All were significant.

These statistical data suggest that both were increased by the
same GNP factor. Also, the data was positively affected by the nation's
economic growth. Furthermore the relationship with the defense burden
has shown some meaningful suggestion that both foreign trade factors
were more rapidly changed compared to the defense burden. If these
simple correlations are positively related, then it could be predicted
that the defense burden depends upon the foreign trade trends which would
imply a decreased pattern and that the nation's economy did not grow
enough!

5. External Resources and Others

During the observed period, Korea has received various types
of inflowing resources from foreign countries. An average annual 5.8
percent of GNP, economic aid, loan, foreign investment, and military
aid.

By the year to year analysis in Chapter II, the inflowing ex-
ternal resources changed its trends and types. In the early 1960s most
of external resources were economic aid, and after 1966 the pattern was
changed from economic aid to loan and foreign investment. Also, mili-
tary aid decreased since 1969. But these resources encouraged, promoted
and changed the nation's economic development and economic patterns from
a dependent to an independent economy.

The simple correlation between the GNP and total external re-
sources was highly positively correlated as 0.9514. A positive correla-
tion of 0.8697 for defense expenditure is also statistically significant
at the 5% level. Between the defense burden and external resources, in
terms of a portion of GNP, correlation was 0.0909 and was statistically
not significant. But military assistance and defense burden were statis-
tically significant ($r = 0.8783$, $F = 47$).

From these results the author found that the total external
resources affected the nation's build up greatly. However, it was not
correlated with the defense burden, which was dependent upon military
assistance.

Next the simple correlation between the armed forces size and
population was 0.9421, while defense burden and armed forces size was
0.8678, both of which were significant. These suggest that armed forces
size did not change but steadily maintained its size. In accordance
with the World Arms Trades (1975), Korean active armed forces were

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estimated at 634,000 men. This size was maintained during the observed period.

Considering the military services and economic effects in a developing country, the military establishment is an important force for modernization. If it is to be at all effective, it has to be largely utilitarian and efficiency-oriented in its approach. It also inculcates in those it trains a great many modern attitudes and aptitudes [10]. Therefore, maintaining the size of the armed forces has not only negative effects, but also some positive secondary effects for the nation's economic growth.

C. MULTIPLE REGRESSION ANALYSIS

In multiple regression analysis, the prediction equations were defined by two major groups; one was the prediction models of the defense expenditure based on the basic data (actual budget), and the other was the defense burden based on the composition data (% of GNP). Also, the equations of each group were performed on its own budget; including U.S. military assistance.

All of the equations of the model were estimated initially using ordinary stepwise linear regression analysis methods. The final results of four key multiple regressions are presented. The last stage of stepwise regression analysis after variables have been entered and their effects computed are also presented. (More detailed information on each step of the calculation is given in the Appendix.)

1. Predictive Model of Defense Expenditure (Basic Data)

a. Defense Expenditure (Own Budget)

The stepwise linear regression discussed above resulted in the following multiple linear regression equation:

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defense expenditure = $-99.24 + 1.793x_2 - 0.128x_3 - 0.876x_4$

where independent variables are:

x_2: Government consumption expenditure

x_3: Private consumption expenditure

x_4: Investment (Gross capital formation)

The F ratio for the whole regression is 321 which indicates that the level of the test is higher than 0.01 (DF: 3,12), that is, the probability that all of the regression coefficients are not zero is at least 0.99. This multiple regression coefficient shows the joint relationship of defense expenditure to a set of variables of GNP; government consumption expenditure, private consumption expenditure, and investment.

The F ratio test for each regression coefficient in the equation above along with the associated probabilities are listed as follows:

Regression Coefficient	Value	F-ratio	Probability $b_i \neq 0$
b_2	1.793	130.0	0.99
b_3	-0.128	32.0	0.99
b_4	0.0876	8.7	0.99

The value of the multiple correlation coefficient (R) for this equation was 0.9938. Therefore, the value of the coefficient of multiple determination (R^2) for this regression was 0.9877, i.e., approximately 99% for the variation in the dependent variable (defense expenditure) is accounted for by the net linear association of independent variables x_2, x_3, and x_4.

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b. Defense Expenditure (Including U.S. Military Assistance)

A multiple linear regression was performed using the in-dependent variables $x_2, x_3,$ and x_4.

$$\text{defense expenditure} = -25.4 + 1.44x_2 - 0.09x_3 - 0.08x_4$$

The results of this multiple linear regression were:

Regression Coefficient	Value	F-ratio	Probabilities $b_i \neq 0$
b_2	1.44	31.0	0.99
b_3	-0.09	6.0	0.99
b_4	0.08	2.9	0.90

Correlation coefficient (R) :	0.9774
Determination coefficient (R^2):	0.9343
Overall F value :	92.4
Degree freedom (DF) :	3,12.
Probability that $b_i \neq 0$:	0.99

2. Predictive Model of Defense Burden (Composition Data)

a. Defense Burden (Own Budget = % of GNP)

A linear regression was performed relating the percent of GNP. The resulting equation was:

$$\text{defense burden} = 7.41 + 0.98x_2 - 0.19x_3$$

where variables are:

dependent variable: defense burden (portion of defense expenditure to the GNP)

independent variable: x_2: portion of government consumption expenditure to the GNP.

x_3: portion of private consumption expenditure to the GNP.

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The computed overall F-value of this equation was 7.9; the meaning in this case is that the probability that the value of the regression coefficient was actually zero is 0.01. The coefficient of correlation was 0.7415 and the proportion of variation in the independent variable accounted for is approximately 0.5498.

b. Defense Burden (Including U.S. Military Assistance)

The resulting equation was:

$$\text{defense burden} = -3.05 + 1.58x_2 - 0.11x_3$$

The F ratio test for each regression coefficient in the equation above along with the associated probabilities are listed below:

Regression Coefficient	Value	F-ratio	Probability $b_i \neq 0$
b_2	1.58	29.0	0.99
b_3	-0.11	3.28	0.90

Correlation coefficient (R)   :   0.9244

Determination coefficient (R^2):   0.8544

Overall F-value   :   38.15

Degree freedom   :   2,13.

Probability, $b_i \neq 0$:   0.99

3. Selection of Predictive Models

The following discussion refers to the predictive model reported above 1, 2.

Four equations were found to be statistically related to defense expenditure.

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The author chose two equations including the analysis contained with military assistance because of the historical perspective for Korean defense expenditure as too much affected by the U.S. military assistance and more useful for prediction power for the future.

The predictive models are:

a. Basic Data

defense expenditure = $-25.4 + 1.44x_2 - 0.09x_3 - 0.08x_4$

b. Composition Data

defense burden = $-3.05 + 1.58x_2 - 0.11x_3$

IV.   SUMMARY AND CONCLUSION

In conclusion, this study has shown that the Korean economic devel-
opment has accelerated significantly from 1963. These accomplishments
occurred in spite of high defense burdens pressed by the demands of
the arms race with North Korea and the fact that military aid from the
U.S. has almost ceased.

During the period 1961-1976, the trends of the economic structural
patterns changed from emphasis in the primary sector to the secondary
sector. The contribution of the primary sector to the GNP decreased,
with the secondary sector rising in conjunction with employment patterns.
Economic data indicates that the Korean economic standard of living,
in real terms, has shown significant improvements during the past 16
years.

The expenditure consumptions have expanded in absolute size and
proportionately. However, the portion of GNP was decreased. In
regression analysis, the positive correlation between the defense
burden and the growth rates of GNP that might be anticipated did not
appear. On the contrary, the simple correlation between the defense
burden and growth rates of GNP was negative: Korea with high growth
rates of GNP did not tend to have high defense burden, and vice
versa. The defense burden, which was 10.6 percent in 1961, had fallen
to 6.2 percent by 1976, with an annual average for 1961-1976 of 6.9
percent. The downward trend of the Korean defense burden is another
reason why its growth rates of GNP are relatively so high.

The investment portion of GNP was the most distinct factor which was continuously rising among the sectors of the economy. Combining this fact with a steadily decreasing relative defense burden has perhaps enabled investment to rise.

A continuing high level of investment positively affected the nation's economic growth which indicated that Korean economic achievement was dependent on its investment efforts rather than on defense or other purposes.

The external resources from foreign countries, especially from U.S. economic aid and military assistance, were tangible. If these were not supported by military assistance, the Korean government would have had to raise taxes in order to make up part of that portion of the defense burden. In so doing, it is likely that a major portion of these taxes would have reduced private savings and business investment would have been curtailed. Circumstantially then, such aid was clearly intended to make it possible for Korea to maintain a large military effort, and at the same time to achieve rapid economic progress. Korean resources could then be made available for economic development.

The maintenance of a large military complement would cause not only a high defense burden, but would also contribute valuable economic inputs to it. Specifically, the defense programs make tangible contributions to the economic development by providing civic actions such as education and medical care, as well as vocational and technical training, engaging in a variety of public work functions—building of roads, dams, and disaster relief, etc., and engaging in scientific and technical specialties. Military forces also engage in certain research, development and production activities which diffuse skills, thereby contributing promotion for the secondary economic efforts.

The crucial determinant in Korea's economic and military future
appears to hinge on three things: First, the amount of military
pressure exerted by North Korea--which has occasionally acted with
disconcerting rashness [10]; second, the amount of military and economic
help will not be provided by the alliance as in the past--it will be
borne by the own efforts of R.O.K.; third, the amount of defense
expenditure will be increased in the future, and the economic develop-
ment pattern will be maintained at least to 1970's growth rates.

Areas of further investigation, which are beyond the scope of this
thesis, are suggested as follows:

a. A statistical analysis of the effects of diverting to invest-
ment resources presently given over to defense requirements.

b. An analysis of the effects on investment and economic growth
of either increasing or decreasing resources allocated to defense re-
quirements.

c. The development and application of statistical prediction pro-
cedures, as applied to the regression model, to define the optimal de-
fense burden, consistent with political and economic variables at the
time, that the Republic of Korea can bear.

APPENDIX A: STATISTICAL DATA

1. VARIABLE LIST

2. BASIC DATA-1 : ACTUAL BUDGET & ACTUAL AMOUNT

3. BASIC DATA-2 : MILITARY ASSISTANCE INCLUDED IN DEFENSE
    EXPENDITURE

4. COMPOSITION DATA-1 : AS % OF GNP EXCEPT Y, X13, X14, X15, AND
    X16

5. COMPOSITION DATA-2 : MILITARY ASSISTANCE INCLUDED IN DEFENSE
    BURDEN FROM COMPOSITION DATA-1

VARIABLE LIST

Y = GNP

X1 = DEFENSE EXPENDITURE

X2 = GOVERNMENT EXPENDITURE

X3 = PRIVATE EXPENDITURE

X4 = GROSS INVESTMENT

X5 = AGRI., FORESTRY & FISHERIES

X6 = MINING & MANUFACTURING

X7 = SOCIAL OVERHEAD CAPITAL & OTHER SERVICES

X8 = EXPORTS

X9 = IMPORTS

X10 = EXTERNAL RESOURCES (ECONOMIC AID + LOAN + FOREIGN INVESTMENT)

X11 = EXTERNAL RESOURCES (ECONOMIC AID + LOAN)

X12 = U.S. MILITARY ASSISTANCE

X13 = POPULATION

X14 = ARMED FORCES

X15 = GNP PER CAPITA

X16 = DEFENSE PER CAPITA

X17 = TAX

Actual Budget and Actual Amount

BASIC DATA #1

Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
1961 1164.48	65.97	163.39	950.65	121.35	522.20	141.74	520.54	38.20	106.60	61.90	61.90	59.70	257.66	6.27	45.99	2.56	112.80
1962 1222.93	71.53	167.07	1017.73	119.88	492.17	161.69	567.12	42.96	141.23	75.00	73.30	42.50	265.13	6.27	46.05	2.70	131.82
1963 1328.31	55.65	174.26	1055.51	225.09	532.05	187.07	609.19	46.16	179.22	85.10	83.30	54.00	272.62	6.27	48.72	2.04	117.66
1964 1441.99	51.29	172.15	1124.20	188.18	614.59	200.07	627.33	57.06	133.34	57.30	57.10	38.60	279.84	6.00	51.53	1.83	104.22
1965 1529.70	56.79	181.56	1201.12	197.26	602.65	237.46	689.59	80.29	149.55	52.60	50.60	53.80	287.05	6.04	53.25	1.98	132.32
1966 1719.18	67.47	200.30	1282.37	317.49	667.91	274.62	776.65	122.28	237.92	70.20	65.70	50.30	294.36	5.72	58.40	2.29	185.20
1967 1893.01	72.34	218.08	1356.87	368.32	634.78	334.02	884.21	165.99	320.73	86.40	82.10	52.60	201.21	6.12	61.50	2.40	223.36
1968 2087.12	84.43	240.62	1545.55	509.05	650.08	416.70	1020.34	235.03	468.04	129.90	124.80	78.70	308.38	6.20	67.68	2.74	300.26
1969 2430.45	97.33	264.17	1705.63	714.07	731.48	499.55	1169.42	310.07	583.77	192.40	180.80	42.80	315.44	6.20	76.10	3.09	361.82
1970 2265.26	102.34	281.31	1884.25	704.66	724.59	590.74	1273.93	381.23	642.44	168.30	150.00	42.40	322.41	6.45	80.31	3.17	398.10
1971 2926.22	120.84	311.90	2080.12	746.81	748.46	690.42	1387.94	456.35	773.55	194.30	184.10	74.30	323.63	6.38	85.97	3.67	442.06
1972 3023.63	136.19	325.55	2226.03	667.65	760.93	794.00	1468.70	643.34	801.23	235.70	156.90	48.40	335.05	6.35	50.24	4.06	409.48
1973 3507.45	131.14	336.60	2402.13	919.69	788.43	1035.60	1663.42	1034.29	1087.04	257.20	195.90	46.30	341.03	6.34	102.85	3.85	466.45
1974 3811.27	167.71	387.11	2534.32	1010.56	833.91	1212.09	1765.27	1010.74	1120.43	236.20	158.70	29.20	246.52	6.34	109.86	4.83	577.23
1975 4125.32	201.20	405.67	2683.80	1101.44	893.14	1367.93	1868.25	1174.20	1134.13	337.80	275.80	25.70	352.81	6.34	127.92	6.23	704.77
1976 4757.66	276.52	473.97	2871.15	1268.25	967.17	1711.88	2078.61	1645.67	1397.76	259.70	279.50	19.40	258.60	6.34	132.67	7.71	904.79

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Military Assistance Included in Defense
Expenditure

BASIC DATA #2 (INCLUDED MILITARY ASSISTANCE IN DEFENSE EXPENDITURE)

Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
1961	1194.48	125.67	163.35	950.65	121.35	522.20	141.74	520.54	38.20	106.60	61.90	61.90	59.70	257.66	6.27	45.99	2.56	112.80
1962	1220.98	114.08	167.07	1017.73	115.86	492.17	161.69	567.12	42.96	141.23	75.00	73.30	42.50	265.13	6.27	46.05	2.70	131.82
1963	1326.31	105.65	174.26	1055.51	225.09	532.05	187.07	609.19	46.16	179.22	85.10	83.30	54.00	272.62	6.27	48.72	2.04	117.66
1964	1441.99	65.89	172.15	1124.20	189.18	614.59	200.07	627.33	57.06	133.34	57.30	57.10	38.60	279.84	6.00	51.53	1.83	104.32
1965	1529.70	115.99	181.56	1201.12	197.26	602.65	237.46	669.59	86.29	145.55	52.60	50.60	53.80	287.05	6.04	53.29	1.98	132.32
1966	1715.18	117.77	200.30	1282.37	317.49	667.91	274.62	776.65	122.28	237.92	70.20	65.70	50.30	254.36	5.72	58.40	2.29	165.20
1967	1853.01	124.94	218.06	1356.87	366.32	634.78	334.02	884.21	165.99	320.73	86.40	82.10	52.60	301.31	6.12	61.50	2.40	223.36
1968	2057.12	163.18	246.62	1545.55	509.05	650.08	416.70	1020.34	235.03	468.04	129.90	124.80	78.70	308.38	6.20	67.68	2.74	300.26
1969	2400.49	143.13	264.17	1705.63	714.07	731.48	499.59	1165.42	310.07	583.77	192.40	180.80	42.80	315.44	6.20	76.10	3.09	361.82
1970	2585.26	144.74	281.81	1884.25	704.66	724.59	590.74	1273.93	381.23	642.44	168.30	150.00	42.40	322.41	6.45	90.31	3.17	398.10
1971	2626.82	195.14	311.50	2080.12	742.81	748.46	690.42	1387.94	456.35	773.55	194.30	184.10	74.30	328.83	6.38	85.97	3.67	442.06
1972	3023.83	184.59	325.55	2226.03	667.93	760.93	794.00	1468.70	643.34	801.23	235.70	196.90	48.40	335.05	6.35	90.24	4.06	409.43
1973	3507.45	177.44	336.60	2402.13	919.69	788.43	1035.60	1683.42	1034.29	1087.04	297.20	195.90	46.30	341.03	6.34	102.85	3.85	456.48
1974	3911.27	196.91	387.11	2534.32	1090.56	833.91	1212.09	1765.27	1010.74	1126.43	236.20	198.70	29.20	346.92	6.34	109.86	4.83	577.23
1975	4125.22	226.50	405.67	2693.80	1101.44	893.14	1367.93	1868.25	1174.20	1134.13	337.80	275.80	25.70	352.81	6.34	127.92	6.23	704.77
1976	4757.66	255.92	472.97	2871.15	1268.25	967.17	1711.88	2078.61	1645.87	1397.76	299.70	275.50	15.40	358.60	6.34	132.67	7.71	904.79

As % of GNP Except Y, X13, X14, X15, and X16

COMPOSITION DATA (11% OF GNP EXCEPT Y, X13, X14, X15, X16)

	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
1961	4.90	5.60	13.80	80.30	10.20	44.10	11.90	44.00	3.20	9.00	5.20	5.90	5.00	3.00	2.43	45.97	2.56	9.60
1962	3.10	5.50	13.70	83.40	5.80	40.30	13.30	46.40	3.50	11.60	6.10	6.00	5.50	2.90	2.36	46.05	2.70	10.80
1963	8.80	4.20	13.10	79.50	16.90	40.00	14.10	45.90	3.50	13.50	6.40	6.30	4.10	2.80	2.30	48.72	2.04	8.90
1964	8.60	3.60	11.90	78.00	13.00	42.60	13.80	43.60	4.00	9.20	4.00	4.00	2.70	2.60	2.14	51.53	1.83	7.20
1965	6.10	3.70	11.90	78.50	12.90	29.40	15.50	45.10	5.20	9.60	3.40	2.30	3.50	2.60	2.10	53.29	1.96	8.60
1966	12.40	3.90	11.70	74.60	18.40	38.90	15.90	45.20	7.10	13.80	4.10	3.80	2.90	2.50	1.94	58.40	2.29	10.80
1967	7.80	3.50	11.90	75.40	19.80	34.30	18.10	47.60	8.90	17.30	4.70	4.40	2.80	2.30	2.03	61.50	2.40	12.10
1968	12.60	4.30	11.50	74.00	24.40	31.10	20.00	48.50	11.30	22.40	0.20	6.00	3.80	2.30	2.01	67.68	2.74	14.40
1969	15.00	4.10	11.10	71.30	25.70	30.50	20.80	47.70	12.90	24.30	8.00	7.50	1.80	2.30	1.57	76.10	3.09	15.10
1970	7.90	4.00	10.90	72.30	27.20	28.00	22.80	45.20	14.70	24.80	6.50	5.80	1.60	2.20	2.00	80.31	3.17	15.40
1971	9.20	4.30	11.00	73.60	26.50	26.50	24.40	49.10	16.30	27.40	6.90	6.50	2.60	2.00	1.94	85.97	3.67	15.60
1972	7.00	4.50	10.30	73.60	22.10	25.20	26.20	48.60	21.30	26.50	7.80	4.50	1.60	1.50	1.90	90.24	4.06	13.50
1973	16.70	3.70	9.60	68.50	26.20	22.50	29.50	48.00	29.50	31.00	8.00	5.60	1.30	1.80	1.86	102.35	3.85	13.30
1974	8.70	4.40	10.20	66.50	28.60	21.90	31.80	46.30	26.50	29.40	1.40	5.20	0.70	1.70	1.83	109.36	4.83	15.10
1975	8.30	4.50	9.90	65.00	26.70	21.60	33.10	45.20	28.40	27.40	8.20	6.70	0.60	1.70	1.80	127.92	6.23	17.10
1976	15.20	5.80	10.00	60.30	27.10	20.30	36.00	43.70	34.60	29.40	6.30	5.90	0.40	1.60	1.77	132.67	7.71	19.00

where Y = Growth rate of GNP
X13 = Growth rate of population
X14 = % of population of armed forces
X15 = GNP per capita
X16 = Defense per capita

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Military Assistance Included in Defense
Burden from Composition Date-1

COMPOSITION DATA #2(INCLUDED MILITARY ASSISTANCE IN DEFENSE BURDEN)

	Y	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
1961	4.80	10.60	13.80	80.30	10.20	44.10	11.90	44.00	3.20	9.00	5.20	5.90	5.00	3.00	2.43	45.97	2.56	9.60
1962	3.10	5.40	13.70	83.40	9.80	40.30	13.30	46.40	3.50	11.60	6.10	6.00	3.50	2.90	2.36	46.05	2.70	10.80
1963	8.80	8.30	13.10	79.50	16.90	40.00	14.10	45.90	3.50	13.50	6.40	6.30	4.10	2.80	2.30	48.72	2.04	8.90
1964	8.60	6.30	11.90	78.00	13.00	42.60	13.80	43.60	4.00	9.20	4.00	4.00	2.70	2.60	2.14	51.53	1.83	7.20
1965	6.10	7.20	11.90	78.50	12.90	39.40	15.50	45.10	5.20	9.80	3.40	3.30	3.50	2.60	2.10	53.29	1.98	8.60
1966	12.40	6.80	11.70	74.60	18.40	38.90	15.90	45.20	7.10	13.80	4.10	3.80	2.90	2.50	1.94	58.40	2.29	10.60
1967	7.80	6.70	11.30	75.40	19.80	34.30	18.10	47.60	8.90	17.30	4.70	4.40	2.80	2.30	2.03	61.50	2.40	12.10
1968	12.60	8.10	11.50	74.00	24.40	31.10	20.00	48.90	11.30	22.40	6.20	6.00	3.80	2.30	2.01	67.68	2.74	14.40
1969	15.00	5.90	11.10	71.00	25.70	30.50	20.80	47.70	12.90	24.30	8.00	7.50	1.80	2.20	1.97	76.10	3.05	15.10
1970	7.90	5.60	10.90	72.80	27.20	28.00	22.80	45.20	14.70	24.80	6.50	5.80	1.60	2.20	2.00	80.31	3.17	15.60
1971	9.20	6.90	11.00	73.60	26.50	26.50	24.40	45.10	16.30	27.40	6.90	6.50	2.60	2.00	1.54	85.97	3.67	13.50
1972	7.00	6.10	10.30	73.00	22.10	25.20	26.20	48.60	21.30	26.50	7.80	4.50	1.60	1.90	1.90	90.24	4.06	13.30
1973	16.70	5.00	9.60	68.50	26.20	22.50	25.50	46.00	29.50	31.00	6.00	5.60	1.30	1.80	1.86	102.85	3.85	15.10
1974	8.70	5.10	10.20	66.50	28.60	21.90	31.60	46.30	26.50	29.40	1.40	5.20	0.70	1.70	1.83	109.86	4.83	15.10
1975	8.30	5.30	9.50	65.00	26.70	21.60	33.10	45.20	28.40	27.40	8.20	6.70	0.60	1.70	1.80	127.92	6.23	17.10
1976	15.30	6.20	10.00	60.30	27.10	20.30	35.00	43.70	24.60	29.40	6.30	5.90	0.40	1.60	1.77	132.67	7.71	19.00

APPENDIX B: COMPUTER OUTPUT

1. CORRELATION COEFFICIENTS

   a. BASIC DATA-1

   b. BASIC DATA-2

   c. COMPOSITION DATA-1

   d. COMPOSITION DATA-2

2. SIMPLE REGRESSION RESULTS

   a. ECONOMIC FACTORS WITH GROWTH RATE OF GNP-----
      COMPOSITION DATA-1

   b. ECONOMIC FACTORS WITH DEFENSE BURDEN-----
      COMPOSITION DATA-2

3. MULTIPLE REGRESSION RESULTS

   a. DEFENSE EXPENDITURE-----BASIC DATA-1

   b. DEFENSE EXPENDITURE-----BASIC DATA-2

   c. DEFENSE BURDEN-----COMPOSITION DATA-1

   d. DEFENSE BURDEN-----COMPOSITION DATA-2

I. CORRELATION COEFFICIENTS

a. BASIC DATA-I

REGRESSION ANALYSIS BASIC DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

11/03/77   PAGE   4

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

REGRESSION ANALYSIS BASIC DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

11/03/77   PAGE   5

	X12	X13	X14	X15	X16	X17
X16	-0.52143	0.22336	0.51223	0.93764	1.00000	0.96689
X17	-0.55252	0.52698	0.52691	0.58068	0.96689	1.00000

b. BASIC DATA-2

REGRESSION ANALYSIS BASIC DATA-2

FILE NONAME (CREATION DATE = 11/03/77)

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

11/03/77   PAGE 4

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REGRESSION ANALYSIS BASIC DATA-2

FILE NONAME (CREATION DATE = 11/03/77)

	X12	X13	X14	X15	X16	X17
X16	-0.62143	0.82336	0.51223	0.93784	1.00000	0.96689
X17	-0.55252	0.92698	0.52691	0.98068	0.96689	1.00000

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c. COMPOSITION DATA-1

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REGRESSION ANALYSIS COMPOSITION DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

REGRESSION ANALYSIS COMPOSITION DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

	X12	X13	X14	X15	X16	X17
X16	-0.79525	-0.61257	-0.58824	0.93782	1.00000	0.83575
X17	-0.74365	-0.68552	-0.75068	0.86160	0.83575	1.00000

d. COMPOSITION DATA-2

REGRESSION ANALYSIS COMPOSITION DATA-2

FILE NONAME (CREATION DATE = 11/03/77)

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

11/03/77   PAGE   4

REGRESSION ANALYSIS COMPOSITION DATA-2

FILE NONAME   (CREATION DATE = 11/03/77)

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	X12	X13	X14	X15	X16	X17
X16	-0.76525	-0.81357	-0.68634	0.93742	1.00000	0.83575
X17	-0.74265	-0.82552	-0.75068	0.86160	0.83575	1.00000

2. Simple Regression Results

a. Economic factors with growth rate of GNP (Composition Data-1)

Variable List	Correlation Coefficient	F Value	Significant (5% level)	Degree of Freedom
Gov't consumption expenditure	-0.6275	9.1	S	1,14
Private consumption expenditure	-0.6457	10.0	S	"
Gross investment	0.6501	10.2	S	"
Agri., Forestry and Fisheries	-0.4901	4.43	(0.055 level)	"
Mining - manufacturing	0.4791	4.17	(0.10 level)	"
Social overhead capital and other services ·	0.1309	0.24	NS	"
Exports	0.5235	5.3	S	"
Imports	0.5578	6.3	S	"
External resources 1	0.3027	1.41	NS	"
External resources 2	0.1670	0.40	NS	"
Military assistance	-0.4503	3.561	(0.10 level)	"
Population	-0.5143	5.0	S	"
Armed forces	-0.6169	8.6	S	"
GNP PER CAPITA	0.4719	4.01	(0.10 level)	"
Defense per capita	0.3434	1.87	NS	"
Tax	0.4554	3.66	(0.10 level)	"

b. Economic factors with defense burden (Composition Data-2)

Variable List	Correlation Coefficient	F Value	Significant (5% level)	Degree of Freedom
Growth rate of GNP	-0.5226	5.259	S	1,14
Government Expenditure	0.9042	62.779	S	"
Private Expenditure	0.7277	15.760	S	"
Gross Investment	-0.7476	17.741	S	"
Agri., Forestry and Fisheries	0.7289	15.868	S	"
Mining - Manufacturing	-0.7109	14.308	S	"
Social overhead capital and other services	-0.2474	0.912	NS	"
Exports	-0.6908	12.775	S	"
Imports	-0.7016	13.576	S	"
External Resources 1	-0.0909	9.117	NS	"
External Resources 2	0.0126	-	-	-
U.S. military assistance	0.8783	47.265	S	1,14
Population	0.8072	26.171	S	"
Armed Forces	0.8678	42.697	S	"
GNP PER CAPITA	-0.6899	12.1715	S	"
Defense per capita	-0.4478	3.512	NS	"
Tax	-0.5053	4,800	S	"

3. MULTIPLE REGRESSION RESULTS

a. DEFENSE EXPENDITURE----BASIC DATA-I

REGRESSION ANALYSIS BASIC DATA-1

FILE NONAME (CREATION DATE = 11/03/77)   11/03/77   PAGE 6

*********** M U L T I P L E   R E G R E S S I O N *********** VARIABLE LIST 1
                                                              REGRESSION LIST 1

DEPENDENT VARIABLE.. X1

VARIABLE(S) ENTERED ON STEP NUMBER 1.. X2

		ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
MULTIPLE R	0.96363	REGRESSION	1.	53273.30545	53273.30545	182.00564
R SQUARE	0.92857	RESIDUAL	14.	4097.85500	292.70250	
ADJUSTED R SQUARE	0.92347					
STANDARD ERROR	17.16355					

------ VARIABLES IN THE EQUATION ------

VARIABLE	B	BETA	STD ERROR B	F
X2	0.512240	0.96363	0.04553	182.006
(CONSTANT)	-55.46035			

------ VARIABLES NOT IN THE EQUATION ------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X3	-1.54443	-0.83852	0.02105	30.768
X4	-0.86753	-0.59620	0.03373	7.169

****

VARIABLE(S) ENTERED ON STEP NUMBER 2.. X3

		ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
MULTIPLE R	0.98934	REGRESSION	2.	56154.76445	28077.38224	300.02727
R SQUARE	0.97879	RESIDUAL	13.	1216.57556	93.58277	
ADJUSTED R SQUARE	0.97553					
STANDARD ERROR	9.67362					

------ VARIABLES IN THE EQUATION ------

VARIABLE	B	BETA	STD ERROR B	F
X2	1.538242	2.49171	0.17742	80.139
X3	-0.814375	-1.54443	0.02665	30.758
(CONSTANT)	-59.35063			

------ VARIABLES NOT IN THE EQUATION ------

VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X4	-0.54099	-0.64865	0.03049	8.716

REGRESSION ANALYSIS BASIC DATA-1

FILE NONAME (CREATION DATE = 11/03/77)   11/03/77   PAGE   7

* * * * * * * * * * * * * * * * * * * M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * * *   VARIABLE LIST 1
                                                                                                          REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

VARIABLE(S) ENTERED ON STEP NUMBER 2..   X4

			ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
MULTIPLE R	0.99324	REGRESSION	3.	56666.63941	18888.87960	321.64925
R SQUARE	0.99772	RESIDUAL	12.	704.70104	58.72509	
ADJUSTED R SQUARE	0.99655					
STANDARD ERROR	7.66323					

	--------- VARIABLES IN THE EQUATION ---------				--------- VARIABLES NOT IN THE EQUATION ---------		
VARIABLE	B	BETA	STD ERROR B	F	VARIABLE	BETA IN	PARTIAL TOLERANCE	F
X2	1.79315B	2.81324	0.15675	130.866				
X3	-0.12755B	-1.33193	0.02220	32.976				
X4	-0.04737B-01	-0.54099	0.02968	6.716				
(CONSTANT)	-59.24417							

PAXIMUM STEP REACHED

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REGRESSION ANALYSIS BASIC DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

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********** MULTIPLE REGRESSION ********** VARIABLE LIST 1
                                            REGRESSION LIST 1

DEPENDENT VARIABLE.. X1

SUMMARY TABLE

VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
X2	0.96363	0.92857	0.92857	0.96363	1.759186	2.81324
X3	0.98934	0.97879	0.05022	0.92091	-0.1272645	-1.33163
X4	0.99384	0.98772	0.00892	0.51797	-0.3763050-01	-0.54059
(CONSTANT)					-99.24417	

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b. DEFENSE EXPENDITURE----BASIC DATA-2

REGRESSION ANALYSIS BASIC DATA-2

FILE NONAME (CREATION DATE = 11/03/77)   11/03/77   PAGE   6

* * * * * * * * * * * * * * M U L T I P L E   R E G R E S S I O N * * * * * * * * * *   VARIABLE LIST 1
                                                                                           REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

VARIABLE(S) ENTERED ON STEP NUMBER 1..   X2

MULTIPLE R	0.98290
R SQUARE	0.96610
ADJUSTED R SQUARE	0.96344
STANDARD ERROR	16.64118

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	39201.24362	39201.24362	138.21697
RESIDUAL	14.	3970.75568	283.62541	

------ VARIABLES IN THE EQUATION ------					------ VARIABLES NOT IN THE EQUATION ------			
VARIABLE	B	BETA	STD ERROR B	F	VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X2	0.35290	0.98290	0.04482	138.217	X3	-0.31840	-0.63080	0.02105	8.591
(CONSTANT)	13.47273				X4	-0.85937	-0.52046	0.03373	4.830

* *

VARIABLE(S) ENTERED ON STEP NUMBER 2..   X3

MULTIPLE R	0.97192
R SQUARE	0.97452
ADJUSTED R SQUARE	0.94460
STANDARD ERROR	13.56115

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	40761.82120	20380.91060	110.87681
RESIDUAL	13.	2390.75810	183.90601	

------ VARIABLES IN THE EQUATION ------					------ VARIABLES NOT IN THE EQUATION ------			
VARIABLE	B	BETA	STD ERROR B	F	VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X2	1.24171	2.25735	0.24871	25.186	X4	-0.59328	-0.44015	0.03049	2.884
X3	-0.34534	-1.31840	0.03735	8.591					
(CONSTANT)	12.99157								

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REGRESSION ANALYSIS BASIC CATA-2

FILE NONAME (CREATION DATE = 11/03/77)

* * * * * * * * * * * * M U L T I P L E   R E G R E S S I O N * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

VARIABLE(S) ENTERED ON STEP NUMBER   3..   X4

MULTIPLE R	0.97742		
R SQUARE	0.95535		
ADJUSTED R SQUARE	0.94419		
STANDARD ERROR	12.67367		

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	3.	41245.07549	13748.35850	85.59184
RESIDUAL	12.	1927.52381	160.62698	

--------- VARIABLES IN THE EQUATION --------- | --------- VARIABLES NOT IN THE EQUATION ---------

VARIABLE	B	BETA	STD ERROR B	F		VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X2	1.443135	2.600996	0.25924	30.988						
X3	-0.501981D-01	-1.08035	0.03672	6.022						
X4	-0.233785D-01	-0.55328	0.04905	2.684						
(CONSTANT)	-25.133566									

MAXIMUM STEP REACHED

REGRESSION ANALYSIS BASIC DATA-2

FILE NONAME (CREATION DATE = 11/03/77)   11/03/77   PAGE   8

* * * * * * * * * * * * * * * * * MULTIPLE REGRESSION * * * * * * * * * * * * * *   VARIABLE LIST 1
                                                                                     REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

SUMMARY TABLE

VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
X2	0.95290	0.90803	0.90803	0.95290	1.443135	2.60996
X3	0.97192	0.94462	0.03660	0.91506	-0.9013061D-01	-1.08535
X4	0.97742	0.95535	0.01073	0.93770	-0.83373943-01	-0.59528
(CONSTANT)					-25.35666	

c. DEFENSE BURDEN———COMPOSITION DATA—1

REGRESSION ANALYSIS COMPOSITION DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

11/03/77   PAGE   6

* * * * * * * * * * * * * * * *   M U L T I P L E   R E G R E S S I O N   * * * * * * * * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

VARIABLE(S) ENTERED ON STEP NUMBER 1..   X2

		ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
MULTIPLE R	0.25947	REGRESSION	1.	0.55650	0.55650	1.00225
R SQUARE	0.06731	RESIDUAL	14.	7.77350	0.55525	
ADJUSTED R SQUARE	0.00069					
STANDARD ERROR	0.74515					

———— VARIABLES IN THE EQUATION ————					———— VARIABLES NOT IN THE EQUATION ————		
VARIABLE	B	BETA	STD ERROR B	F	VARIABLE	BETA IN	PARTIAL TOLERANCE	F
X2	0.1509145	0.25847	0.15075	1.002	X3	-1.58003	-0.71944 0.19348	13.548
(CONSTANT)	2.699959							

* *

VARIABLE(S) ENTERED ON STEP NUMBER 2..   X3

		ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
MULTIPLE R	0.74150	REGRESSION	2.	4.57958	2.28979	7.93861
R SQUARE	0.54992	RESIDUAL	13.	3.75002	0.28846	
ADJUSTED R SQUARE	0.41056					
STANDARD ERROR	0.53709					

———— VARIABLES IN THE EQUATION ————					———— VARIABLES NOT IN THE EQUATION ————		
VARIABLE	B	BETA	STD ERROR B	F	VARIABLE	BETA IN	PARTIAL TOLERANCE	F
X2	0.9764221	1.67744	0.24702	15.721				
X3	-0.1930225	-1.58003	0.05170	13.548				
(CONSTANT)	1.4359217							

MAXIMUM STEP REACHED.

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REGRESSION ANALYSIS COMPOSITION DATA-1

FILE NONAME (CREATION DATE = 11/03/77)

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* M U L T I P L E   R E G R E S S I O N *   VARIABLE LIST   1
REGRESSION LIST   1

DEPENDENT VARIABLE.. X1

SUMMARY TABLE

VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
X2	0.25847	0.06691	0.06681	0.25847	0.9794221	1.61744
X3	0.74150	0.54982	0.48301	-0.07357	-0.1930926	-1.53003
(CONSTANT)					7.4059217	

d. DEFENSE BURDEN————COMPOSITION DATA-2

REGRESSION ANALYSIS COMPOSITION DATA-2

FILE NAME (CREATION DATE = 11/03/77)

11/03/77   PAGE   6

* * * * * * * * * * * * * * * * M U L T I P L E   R E G R E S S I O N * * * * * * * * * * * * * * * *   VARIABLE LIST 1
REGRESSION LIST 1

DEPENDENT VARIABLE..   X1

VARIABLE(S) ENTERED ON STEP NUMBER   1..   X2

MULTIPLE R	0.90424
R SQUARE	0.81766
ADJUSTED R SQUARE	0.80463
STANDARD ERROR	0.68391

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	1.	29.79497	29.79497	62.77912
RESIDUAL	14.	6.64440	0.47460	

------------- VARIABLES IN THE EQUATION -------------   ------------ VARIABLES NOT IN THE EQUATION ------------

VARIABLE	B	BETA	STD ERROR B	F		VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X2	1.04259	0.90424	0.13937	62.779		X3	-0.43555	-0.44510	0.19348	3.284
(CONSTANT)	-5.16855									

* *

VARIABLE(S) ENTERED ON STEP NUMBER   2..   X3

MULTIPLE R	0.92436
R SQUARE	0.85444
ADJUSTED R SQUARE	0.83004
STANDARD ERROR	0.63077

ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F
REGRESSION	2.	31.13510	15.56755	36.15378
RESIDUAL	13.	5.30427	0.40802	

------------- VARIABLES IN THE EQUATION -------------   ------------ VARIABLES NOT IN THE EQUATION ------------

VARIABLE	B	BETA	STD ERROR B	F		VARIABLE	BETA IN	PARTIAL	TOLERANCE	F
X2	1.58213	1.29579	0.29378	29.012						
X3	-0.11430	-0.43599	0.06149	3.284						
(CONSTANT)	-3.64810									

MAXIMUM STEP REACHED

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REGRESSION ANALYSIS COMPOSITION DATA-2

FILE NAME (CREATION DATE = 11/03/77)

***************** M U L T I P L E   R E G R E S S I O N *****************

DEPENDENT VARIABLE.. X1

11/03/77   PAGE 7

VARIABLE LIST 1
REGRESSION LIST 1

SUMMARY TABLE

VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
X2	0.90424	0.81765	0.81765	0.90424	1.582413	1.29579
X3	0.92436	0.85444	0.03678	0.72772	-0.1114390	-0.43599
(CONSTANT)					-3.048510	

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